Volume II
Technical Appendices

Independent Oversight
Inspection of
Environment, Safety,
and Health Management
at the

Lawrence Livermore National Laboratory

ISM

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Acronyms

ALARA	As Low As Reasonably Achievable
CAIRS	Computerized Accident/Incident Reporting System
CAP	Corrective Action Plan
CAS	Condition Assessment System
CFR	Code of Federal Regulations
CY	Calendar Year
D&D	Deactivation and Disposition
d.p.	Differential Pressure
DNFSB	Defense Nuclear Facilities Safety Board
DNT	Defense and Nuclear Technologies
DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
ECP	Employee Concerns Program
EH	Office of Environment, Safety and Health
EM	Office of Environmental Management
EPA	Environmental Protection Agency
EPD	Environmental Protection Department
ERD	Environmental Restoration Division
ES&H	Environment, Safety, and Health
FEOSH	Federal Employee Occupational Safety and Health
FIRP	Facilities and Infrastructure Recapitalization Program
FPOC	Facility Point of Contact
FRAM	Functions, Responsibilities, and Authorities Manual
FSP	Facility Safety Plan
FY	Fiscal Year
GFCI	Ground Fault Circuit Interruption
HAC	Hazards Assessment and Control Form
HEPA	High Efficiency Particulate Air
HCT	Hazard Control Technician
HP-DAP	Health Physics Discipline Action Plan
IFM	Institutional Facilities Management
ISM	Integrated Safety Management
ISMS	Integrated Safety Management System
ISO	International Organization for Standardization
ITS	Issues Tracking System
IWS	Integration Work Sheet
LLNL	Lawrence Livermore National Laboratory
LSO	Livermore Site Office
MSDS	Material Safety Data Sheet
NFPA	National Fire Protection Association
NIF	National Ignition Facility
NMTP	Nuclear Materials Technology Program
NNSA	National Nuclear Security Administration
OA	Office of Independent Oversight and Performance Assurance
OAIP	Operational Awareness Implementation Plan
ORPS	Occurrence Reporting and Processing System
OSHA	Occupational Safety and Health Administration

Acronyms (continued)

OSP	Operational Safety Plan
PAT	Physics and Advanced Technologies
PHA	Preliminary Hazards Analysis
PISA	Potentially Inadequate Safety Analysis
PPE	Personal Protective Equipment
QA	Quality Assurance
R&D	Research and Development
RMA	Radioactive Material Area
ROD	Record of Decision
SAR	Safety Analysis Report
SFTF	Small Firearms Training Facility
SOP	Standard Operating Procedure
TAG	Technical Administration Group
TQP	Technical Qualification Program
TSR	Technical Safety Requirement
TYCSP	Ten Year Comprehensive Site Plan
UC	University of California
USQ	Unreviewed Safety Question
USQD	Unreviewed Safety Question Determination
w.c.	Water Column

APPENDIX C

Core Function Implementation (Core Functions 1-4)

C.1 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Independent Oversight and Performance Assurance (OA) evaluated work planning and control and implementation of the first four core functions of integrated safety management (ISM) for selected Lawrence Livermore National Laboratory (LLNL) activities. The OA review of the ISM core functions focused on environment, safety, and health (ES&H) programs as applied to six selected aspects of LLNL activities:

- Nuclear Materials Technology Program (NMTP) nuclear facility programmatic operations (Section C.2.1)
- Physics and Advanced Technologies (PAT) Directorate research and development (R&D) activities (Section C.2.2)
- Maintenance activities (Section C.2.3)
- Construction (Section C.2.4)
- Waste management operations (Section C.2.5)
- Environmental restoration activities (Section C.2.6).

For all the above areas, OA reviewed procedures, observed ongoing operations, toured work areas, observed equipment operations, interviewed managers and technical staff, reviewed interfaces with ES&H staff, and reviewed ES&H documentation (e.g., permits and safety analyses). Specific processes in each area and OA team activities are discussed further in the respective results sections.

C.2 RESULTS

In addition to evaluating the selected six aspects of LLNL activities, OA also evaluated the collective results of the application of the core functions in the six selected areas to identify commonalities. As discussed below, the evaluation of the collective results provides perspectives on the sitewide work control processes.

With respect to the core functions, LLNL has established institutional policies and procedures for ISM. These include mature institutional work control and hazards analysis processes, which have been in place for about four years. These processes are generally well documented in various LLNL documents.

However, the evaluation of the collective results identified four findings that indicate systemic deficiencies in implementation of the sitewide work control processes across a wide range of LLNL facilities and activities. While there are a number of exceptions (e.g., most waste management activities had effective controls, and the National Ignition Facility [NIF] had effectively implemented the LLNL work control processes for construction activities), the four findings below were sufficiently prevalent across the six areas reviewed by OA to warrant attention at both the organizational and institutional level and corrective actions on a sitewide basis, to include facilities and activities not reviewed by OA on this inspection. These four institutional-level findings are presented below for easy reference and are briefly discussed. Additional observations leading to these four findings are addressed in more than one of the six areas reviewed. The results section for each of the six areas reviewed (subsections C.2.1 through C.2.6) includes references to findings, where applicable.

For the most part, the institutional work control requirements are adequately defined in various documents, such as the integration work sheet (IWS) system and the NMTP work control process manuals, and high-level safety requirements are adequately defined in such LLNL documents as the ES&H Manual. However, within several LLNL directorates, divisions, and departments, LLNL management has not ensured that the institutional requirements are adequately implemented at the activity level during work activities and supporting ES&H activities. Most of the organizational elements reviewed did not adequately implement one or more elements of institutional requirements. For example, the IWS process, as implemented by the PAT Directorate, in several cases has not sufficiently identified, analyzed, and/or documented all the appropriate hazards or hazard controls for a research activity, ensured that all work other than that which is commonly performed by the public is addressed in an IWS/safety plan, or adequately defined ES&H training requirements. A contributing factor is that some important safety provisions in the ES&H Manual are identified as recommendations rather than mandatory requirements, and the direction for implementing the recommendations is not sufficient to ensure that safety requirements will be effectively evaluated and implemented.

Finding #1. Within several LLNL directorates, LLNL management has not fully and effectively implemented the integration work sheet system and institutional ES&H requirements.

In some cases, failure to implement requirements stemmed from inadequate flowdown of the institutional safety requirements to division-level requirements documents (e.g., safety program plans). In these cases, the division-level documents, which are typically used by workers, did not adequately incorporate institutional safety requirements and contributed to site safety requirements not being implemented. At the activity level, many activities involving hazards had no work instructions, or the work instructions had errors or omissions such that they did not provide adequate instructions to the workers. In cases where LLNL had procedures that govern work activities, the quality of many of the procedures was poor, and the procedure steps could not always be implemented verbatim as they were written. For example, the NMTP radiological control procedures, practices, and work instructions are not developed, sufficiently rigorous, or maintained current to ensure the adequacy and accuracy of controls.

Finding #2. LLNL management has not ensured that requirements are clearly defined and communicated in accurate work instructions (i.e., procedures, requirements documents, permits, and other documents that define safety requirements and how to properly implement them).

In those cases where requirements are adequately defined, there were a number of instances where the requirements were not implemented as specified in the work instructions. For example, Building 332 personnel have not applied sufficient rigor or attention to detail in following existing safety requirements or seeking modification or clarification of requirements. In addition, LLNL does not have adequate directions that define expectations for procedure/work instruction usage (e.g., when and how procedures need to be used, how procedures are approved, and expectations for verbatim compliance). As a result, many LLNL workers indicated an incorrect belief that work instructions are guidelines rather than mandatory requirements. In accordance with conduct of operations principles, when work instructions/procedures have errors or omissions, the proper action is to stop the work activity to change the work instructions/procedures. At LLNL, many workers had a tendency to ignore inadequate procedure steps or requirements and to rely on their expertise to perform actions they thought were appropriate, rather than implement the conduct of operations principles (i.e., follow the requirement as written, or stop and correct the requirement). Management was aware of, condoned, and, in some cases, reinforced this approach to non-verbatim compliance.

Finding #3. Within several LLNL directorates, LLNL management has not provided clear expectations for verbatim compliance with requirements and procedures, contributing to a number of instances where safety requirements were not implemented as written and/or the procedure was not corrected before proceeding with the work.

As discussed above, many LLNL work instructions are not adequate and requirements are not always implemented as specified. A contributing factor is the ineffective processes for identifying and correcting deficiencies in work instructions and implementation of requirements. For example, processes for getting feedback from workers on the adequacy of procedures/work instructions were not used and, as a result, inadequate procedures/work instructions generally do not get corrected as they are used. Similarly, LLNL processes for monitoring activity-level work to determine whether workers are effectively implementing requirements were not used or were not effective; as a result, worker performance and attitudes toward procedure compliance are not adequately monitored such that deficiencies can be identified and corrected.

Finding #4. LLNL management has not ensured that deficiencies in work instructions and implementation of requirements at the work-activity level are identified and corrected.

Collectively, the deficiencies in the work control process indicate that, although the work control process has been in place for four years, there is still a significant reliance at LLNL on an expert-based approach to safety, rather than the ISM principle of clear standards and requirements. The following subsections provide examples of deficiencies in the six areas (NMTP, PAT, maintenance, construction, waste management, and environmental restoration) that support the four findings above.

C.2.1 Nuclear Materials Technology Program

OA's evaluation of implementation of the first four core functions of ISM for the NMTP activities focused on evaluation of safety performance of laboratory programmatic activities primarily in Building 332, the Plutonium Facility, with evaluation of one program activity in Building 331, the Tritium Facility. Because of the special considerations associated with nuclear facility operations, NMTP Superblock facilities are not bound by the LLNL IWS work control process, but instead rely on separate processes defined at the facility and division levels. All activity-level work at the Plutonium Facility is controlled and authorized by the facility manager using the *Plutonium Facility – Building 332 Work Control/Design Control Change Process Manual*, which divides work activities into five categories (A through E). Category A and B activities are routine, low-hazard activities that have been previously analyzed, with the appropriate controls documented in the Building 332 facility safety plan (FSP), the LLNL ES&H Manual, and other approved procedures. The majority of the specialized programmatic work is categorized as Category C, requiring documentation of the specific scope of work on a work permit, and the hazards analysis and associated controls in an operational safety plan (OSP) that supplements the FSP and LLNL ES&H Manual. Category D work is other activity-level work not covered by the hazards analysis and controls specified in A, B, or C categories. Category D activities require a work permit, a specific hazards analysis, and a set of corresponding controls as part of the work package. Category E activities are new processes or facility modifications and also require a work permit, a specific hazards analysis, and a set of controls as part of the work package. A similar process using four work categories is described in the *NMTP Category 3 Nuclear Facilities and Superblock Yard Work Control Manual*.

Activities observed by OA in Building 332 included OSP training; glovebox operations in metallography, machining, chemical processing, and waste processing laboratories; response to glove failures, a continuous air monitor alarm, and personnel contamination; and area and equipment decontamination from a large contamination event. OA also observed tritium recovery operations in Building 331. Administrative and engineering controls associated with the observed activities were also evaluated.

Core Function #1: Define the Scope of Work

The scopes of work for observed program activities in Buildings 332 and 331 are adequately described in facility safety and operations documentation. Facility-level program activities are described in each facility's currently approved safety analysis report and are further described in the FSPs. Operations within laboratories or workstations are described in facility procedures, permits, guidelines, and OSPs. The OSP serves as the primary mechanism defining the scope of authorized activities within each laboratory. The level of detail provided in OSPs was extensive and detailed the specific operations, processes, and activities to be performed at each individual workstation within a laboratory. The scope of work for non-routine activities, including those not covered by an operational OSP, is detailed in a work permit for the task. Individual scopes of work for work permits reviewed during the inspection were also adequate. Material specifications (both incoming material and outgoing parts or products) are provided in material specifications, process specifications, parts lists, or other documented requests from associate program leaders. The details provided in these documents are sufficient to permit effective hazard identification and analysis of operational activities

Summary. The scope of work and schedule for NMTP work is generally well defined through facility and activity descriptions and program documents.

Core Function #2: Analyze the Hazards

NMTP uses a combination of processes to effectively identify hazards associated with activity-level program work. FSPs identify and document hazards and controls for activities that are routinely conducted to support facility operations. For example, gloveboxes are used throughout the Plutonium Facility, and generic hazards and associated controls for routine glovebox operations, such as bag-in and bag-out activities, are contained in the Building 332 FSP. For specific laboratories and workstations, applicable OSPs provide a comprehensive listing of potential hazards associated with the work. OSPs for programmatic work are reviewed and updated annually. The OSP responsible individual, with assistance from ES&H Team 1 subject matter experts, develops the OSP by identifying applicable hazards associated with each work evolution and then developing appropriate controls. Accuracy of the hazard information in the OSPs is ensured primarily through the proper involvement of ES&H disciplines as well as the review and approval process, which includes facility safety staff, facility management, and ES&H team management. A similar hazards analysis process is used to analyze hazards associated with work activities covered by Category D work permits. For these efforts, the facility routine work permit meetings are held for ES&H disciplines and the work authors to meet and formulate a draft work permit that identifies the applicable hazards and associated controls. Walkdowns are scheduled as necessary where more complex activities require visual inspection of the work area to properly evaluate hazards. With a few minor exceptions, Category D work permits active at the time of the OA evaluation adequately identified the hazards.

While hazards associated with most work activities were sufficiently covered by OSPs and work permits, one anomaly was observed. In this case, the hazards associated with the potential for secondary radiation (bremsstrahlung) or encountering radioactive materials other than tritium in the Building 331 tritium recovery and recycle work was not sufficiently analyzed, resulting in potentially inadequate controls. Because of its very low beta energy, tritium cannot normally be detected by conventional radiation monitoring equipment, and measurements around the work area with a conventional Geiger-Mueller detector revealed elevated radiation levels, which initially could not be explained. Upon further review, LLNL personnel believe that these external radiation fields are the result of bremsstrahlung (X-ray) radiation caused by interactions of tritium beta particles with metallic materials in the devices being disassembled. While this is possible, hazards from bremsstrahlung radiation are not discussed in the work permit or FSP, and the controls specified in the work permit only address tritium contamination. The need for or lack of other controls for external radiation (i.e., exposure rate surveys, dosimetry) is not specified or discussed in work planning documentation for this work. Additionally, because many military surplus luminous parts contain isotopes other than tritium (i.e., radium), it is possible for Building 331 to receive isotopes other than tritium. Without specific controls to evaluate and discriminate tritium from other isotopes that may be present in luminous parts, the potential exists for unknowingly working outside the bounds of the anticipated hazards (see Finding #1).

Summary. With one exception, work activity hazards were sufficiently identified and analyzed by FSPs, OSPs, and work permits. In Building 331, increased analysis is needed to ensure that all hazards associated with tritium recovery operations are adequately addressed.

Core Function #3: Identify and Implement Controls

Building 332 relies extensively on the use of engineered controls, which serve as a primary mechanism to control many activity-level hazards. Engineered controls include containment devices, such as gloveboxes and hoods, and ventilation systems specific to the work. Engineered controls are complemented by a variety of administrative controls, including FSPs, OSPs, work permits, administrative procedures, and work instructions prepared to control a particular activity. In most cases, the work control process for NMTP work activities produces a generally adequate set of hazard controls. However, there are a number of specific deficiencies and instances where the controls were not effectively established and implemented, as described below.

In general, the ES&H Manual, the FSP, and the OSP combine to provide the appropriate controls for program work. Although the controls are spread among several documents, the controls unique to an activity are contained in the OSP in most cases. For example, the OSP for a metallography workstation identifies the specific type of approved glovebox and personal protective equipment (PPE) glove for each type of chemical used in the process. The OSPs also provide equipment-specific hazards and associated controls unique to an activity. For example, the OSP for pyrochemical operations identifies the hazards and provides appropriate controls for specific process equipment, such as a hydraulic press, furnaces, and furnace lid lifting hoists. Overall, the OSPs provide an effective mechanism to communicate activity-specific hazards and controls.

NMTP uses several channels of communication to communicate safety topics to workers. For example, NMTP holds a quarterly safety meeting to convey information on a variety of safety-related topics to all staff, including updates of significance over the previous three-month period. In addition to the quarterly safety meeting, individual facilities also hold weekly safety meetings, where the smaller size is more conducive to open discussions. Overall, the meetings are useful forums for exchange of safety information between management and staff. Other mechanisms, such as postings and memorandums, provide diverse and appropriate channels to communicate safety topics to workers.

Training in Building 332 also substantially contributes to the strong knowledge base of the workers. For example, fissile material handlers undergo an extensive training and certification process, including comprehensive written examinations and oral boards. Health and safety technicians undergo a formal training and qualification process and are tested on a variety of job performance measures needed to perform their duties. Health and safety technicians were knowledgeable of their job functions and facility requirements. In another example, employees are formally trained every six months on each OSP for which they are authorized to work. In addition, they must pass a written test on each applicable OSP annually. An observed six-month training session was effective at presenting high points to the workers, as well as highlighting any changes to the OSP. The accompanying test was challenging, with the appropriate level of detail in a combination of multiple choice and true-or-false questions. The test process also contained the appropriate criteria for passing the test and remedial training requirements for all questions missed.

Although many hazard controls were appropriately identified, weaknesses existed in the identification and implementation of some controls, as discussed in the following paragraphs.

In Building 331, controls for work involving disassembly and recovery of tritium from surplus military parts are contained in a work permit for the activity and the Building 331 FSP. While most of the controls specified for tritium are appropriate, including PPE, air monitoring, and bioassay requirements, the contamination controls specified in the work permit require only swipe sampling at the start and end of the job. In this work, components containing up to ten curies of tritium within a tube or ampoule are dismantled and the tritium containing tube or ampoule is removed by hand and placed in a collection container for subsequent transfer to a glovebox for recovery. The requirement to perform swipe sampling only at the start and end of the job may not be sufficient to detect and prevent the potential inadvertent spread of contamination to non-contaminated areas, including times when individuals leave the room for breaks or other activities. As such, any contamination that might be present may be spread outside the immediate area and not be detected until work is secured for the day.

In a few OSPs, controls for some hazards are incomplete or too generic to effectively control the identified hazard. For example, several OSPs list electrical hazards and state that over time, radiation could degrade protective insulation on electrical equipment; however, the listed controls only state that the electrical safety controls in the LLNL ES&H Manual shall be followed. They do not provide specific controls to address the increased hazard from radiation degradation of insulators. See the Core Function #4 section for a related discussion of failure to follow the electrical safety controls in the LLNL ES&H Manual. In another example, the OSP for fissile material handling identifies lead as a hazard, but fails to provide sufficient controls to protect workers from airborne lead oxide when opening legacy containers. This lack of controls contributed to a first aid case in August 2004, where a worker's eyes were contaminated with lead oxide powder when opening a container. Although management initiated actions to replace the aging containers, management did not immediately initiate formal actions to implement appropriate controls to prevent recurrence during operations involving the remaining containers (see Findings #2 and #4 and Appendix D for further discussion).

The nature of some work in Building 332 involves relatively significant external radiation exposures to some workers. Actual radiation doses and as-low-as-reasonably-achievable (ALARA) goals for these individuals are as high as two rem per year. Document 20.4 of the ES&H Manual requires that a formal ALARA review be performed and documented for any operation where individual whole-body doses are expected to exceed 100 mrem or where the collective dose exceeds one rem. "Operations" are defined as those activities governed by an authorizing work document (i.e., the OSP). Topics to be addressed by formal ALARA reviews are detailed in the ES&H Manual and include estimates of individual and collective doses, identification of tasks that result in a disproportionate fraction of the dose, and identification of applicable ALARA controls and alternatives designed to reduce the doses. ALARA controls stemming from the review are to be incorporated into the safety plan or OSP for the operation. The ES&H Manual also requires program management to maintain records of these formal ALARA reviews.

Significant efforts have been expended by program and hazards control personnel in Building 332 to integrate the ALARA philosophy into programmatic work. For example, individual ALARA goals for workers are formally developed and routinely monitored, and additional engineering controls have been put in place to reduce doses at some workstations (e.g., installation of glovebox shielding). Interoffice correspondence between program personnel and ES&H health physicists also demonstrates informal activities and discussions with regard to dose reduction techniques. In addition, a few formal ALARA plans for specific activities have been developed; although appropriate, the reasons for performing these activities were subjective rather than based on defined requirements from the ES&H Manual.

Despite these actions, a systematic approach to the conduct of formal ALARA reviews that meet ES&H Manual requirements has not been demonstrated for all operations covered by OSPs and which have the potential to exceed applicable dose thresholds. For example, formal ALARA reviews have not been conducted for some OSP activities in rooms 1378, 1010, and 1353, where some workers accumulate external doses well in excess of ALARA review thresholds. ALARA plans that have been developed for specific operations have not always contained all information stipulated in Document 20.4, and where specific ALARA controls have been developed for individual activities, these controls have not always been integrated into the OSPs governing the work. Most OSPs did not contain any specific information on task-specific doses or a complete listing of ALARA controls to be employed during the work. A complicating factor is that individual doses are not tracked by workstation or task, so determining where workers receive the majority of their dose and which activities may meet thresholds for ALARA reviews cannot always be properly ascertained as required. The absence of a systematic approach to the conduct of formal ALARA reviews results in an inability to demonstrate whether optimization of exposure reduction has occurred or whether current ALARA goals are appropriate. This is a repeat concern from the 2002 OA safety management evaluation.

Finding #5. Formal ALARA reviews for some operations in Building 332 that meet applicable dose thresholds have not been performed and results have not been integrated into work documents as required by ES&H Manual Document 20.4, resulting in an inability to demonstrate that doses are being maintained ALARA and that ALARA goals are appropriate.

In the area of operational radiological protection, ES&H Team 1 health and safety technicians are responsible for implementing many of the radiological health and safety controls in Building 332. While generally adequate, a weakness in document control, insufficient procedural instruction for performance of some duties, and/or a lack of rigor in understanding or following existing requirements has resulted in the potential to compromise the adequacy of radiological controls and/or radiological data used for decision-making.

With respect to document control, the Health Physics Discipline Action Plan (HP-DAP) is a directives document mandated by the institutional Hazards Control Department to direct health and safety technician routine radiological activities in the facility. The HP-DAP references and mandates the use of another document, the Swipe Manual, for calibration and operation of the swipe counters and for calculation of removable activity. However, current controlled copies of the Swipe Manual do not exist and are not available from the Hazards Control Department. According to the Hazards Control Manual, Chapter 33, a current version of this document is under development. Management's expectations as to the method for personnel to obtain an official copy of the Swipe Manual are not specified. A copy of a Swipe Manual contained in the Building 332 Radioactive Material Area (RMA) is dated 1995 and shows an invalid controlled document number on the cover. This document contains information that is outdated, inaccurate, and not relevant to current operations. Because the document is no longer controlled, it would be difficult to determine whether all existing versions of the document in use across the laboratory contain the same information and whether personnel are utilizing appropriate information to analyze samples as required by the HP-DAP (see Finding #2).

The existence of implementing procedures to drive performance of radiological duties is both mandated and recommended by several sources, including 10 CFR 830, 10 CFR 835, and DOE Radiological Control Standards. In some cases, field operations instructions or procedural requirements are not sufficient for technicians to adequately fulfill their assigned radiological duties in Building 332. For example, the lack of an adequately detailed procedure for operational checks of the hand and foot monitors has resulted in incomplete checks by technicians and inability to demonstrate that the units will function properly to detect contamination. While daily hand and foot monitor checks are required by the HP-DAP, the protocol for conduct of these checks is left entirely to the discretion of the health and safety technician. OA's observation of this activity identified several deficiencies, such as failure to ensure reproducible geometry, including where and how to place sources on the detector to initiate a proper alarm; lack of knowledge of how to test the attached hand probe; and allowance for multiple attempts after failure to allow a counter to pass the performance test. None of these items are addressed in a specific procedure or protocol outlining expectations for performance testing (see Finding #2).

In another example, formal expectations as to the proper procedure for collection of passive air samples by health and safety technicians are not documented in a procedure, and actual practices do not comply with information presented in the health and safety technician job performance measures and the HP-DAP. JPM HS-6735 (to which technicians are trained and qualified) states that the date and time the air sampler was started and stopped is to be documented on a survey form or log sheet. Further, the HP-DAP states the technician is to "identify filters as to the sampling location, sampling dates, and either total airflow or airflow rate and sampling duration." Contrary to these requirements, air sample volumes are not formally tracked with either start and stop times or total sampler flow. In practice, only dates are entered into the STAR database and the database automatically calculates total sample flow using a default run time of 24 hours per day. Because replacement of individual sample filters does not occur at the same time each day, a run time of 24 hours is rarely accurate, and the resulting calculation of airborne activity concentration is also not accurate. While it may not be significant under some conditions, LLNL has not documented the rationale and justification for this practice, including acceptable time tolerances, data quality objectives, and relative significance or insignificance of failing to use accurate values for air sample volumes (see Findings #2 and #3).

In addition, because passive air samples and continuous air monitors are often pulled more than once per day because of contamination events, use of the STAR database default run time of 24 hours per day may at times be grossly inaccurate, particularly when attempting to characterize short-duration events. In these cases, sampler start and stop times are needed to accurately calculate sampled air volume. However, this information is not recorded, and thus the data (if needed) would have to be re-created based on a technician's best estimate. This practice is contrary to sound sample chain of custody and data logging practices. There is no formal instruction or facility requirement as to how sampler air volumes are to be calculated when they are needed, or when the level of accuracy in the air sampling results is important enough to warrant an override to the STAR database default calculation of air volume. Such decisions are left to the subjective discretion of the health and safety technician (see Finding #2).

Summary. In most cases, the NMTP effectively uses a combination of engineering and administrative controls to ensure prevention and/or mitigation of hazards associated with programmatic operations. However, weaknesses in implementation of some controls jeopardize their effectiveness. For example, some radiological work instructions and requirements are not developed or sufficiently rigorous to ensure proper implementation of controls. Increased management attention is needed in these areas to ensure that all hazards are appropriately and rigorously controlled.

Core Function #4: Perform Work Within Controls

Building 332 publishes a daily activity list and holds a daily activity list meeting to effectively identify and authorize all facility work for the upcoming day. The daily activity list is generated from currently approved facility work permits, and is reviewed and updated each day during a formal meeting with representatives from all program elements. Because of Building 331's smaller size and workload, NMTP publishes a weekly activity list that authorizes work for the week in that facility.

In most cases, highly skilled, experienced, and dedicated workers safely performed programmatic work activities, using established controls and appropriate PPE. Building 332 personnel performed appropriate glove checks and bag-out practices as specified in the FSP while performing program work. Material handlers utilized the blue alpha meters as appropriate to perform integrity checks on glovebox gloves prior to use and performed dose rate measurements on bagged out material. Workers performed glovebox bag-outs appropriately, including careful contamination control techniques, such as securing the bag with duct tape prior to cutting, and performing extensive radiation surveys. Following each use of glovebox gloves, personnel appropriately surveyed their hands as required by the FSP.

In response to separate glove breaches and a continuous air monitor alarm, the initial response of Building 332 personnel, including health and safety technicians and material handlers, was appropriate. This initial response included donning respiratory protection, securing the scene, minimizing the potential spread of contamination, notifying health physics professional support, and assisting the affected individuals with egress. Health and safety personnel have also prepared a pre-staged emergency response cart with all necessary equipment and supplies to quickly and effectively respond to these types of events.

While many work evolutions are performed safely in accordance with established controls, a number of examples of failure to follow established safety rules or requirements are described below and indicate a need for additional management attention in this area.

Building 332 management demonstrated a non-conservative approach to compliance with the work control manual as evidenced by their actions taken to characterize and decontaminate a laboratory following a large contamination event. A glovebox glove failure on October 19, 2004, resulted in a large contamination event (as defined by the FSP) and suspected personnel intake. Facility workers initially responded appropriately to decontaminate the person involved and isolate the air inleakage to the inert glovebox. However, following the initial response, facility management did not initiate a work permit package with the associated hazards analysis documentation to characterize the extent of laboratory contamination, decontaminate the area, and return the area to normal operations. Management stated that they do not normally use the work permit process to plan and control these types of decontamination work activities. Management treats these cleanup and recovery activities as Category A activities (defined by the work control manual as ongoing or routine, low-hazard activities not requiring a work permit) instead of Category D activities (defined by the work control manual as generally higher hazard, less routine operations requiring a work permit, such as "decontamination of enclosures, contaminated equipment or laboratories," or "any job that presents a potential health hazard to personnel but is not administratively controlled by an OSP"). Instead of a work permit package, management used information generated from a recovery plan meeting (documented by meeting minutes) to identify hazards and controls, including respiratory protection and other PPE. The meeting minutes were not complete in definition of PPE requirements or radiological controls, and some controls, such as requirements for high-volume air sampling and use of double gloves, were verbally conveyed without documentation. This approach is not in accordance with the FSP, which states that jobs not covered by an OSP and requiring respiratory protection shall be evaluated by the health physicist on a case-by-case basis and specified on a work permit. This FSP requirement is supported by assumptions in the Building 332 safety analysis report, which characterizes glove failures as abnormal events and states that PPE requirements for specific jobs (other than general operations) are determined by the health physicist and specified in a work control document. The FSP also requires that downgrading of respirator requirements must be specifically authorized by a work permit or an OSP; however, in this case, the removal of respirator requirements was documented by a handwritten note in the margin of the meeting minutes located at the job site (see Findings #2, #3, and #4).

In addition, for this contamination event and other previous contamination events, NMTP management did not follow the LLNL ES&H Manual occurrence reporting requirements. The October 19, 2004, event technically met the occurrence reporting criteria for spread of contamination as listed in the LLNL ES&H Manual. However, until questioned by OA, Building 332 facility management did not report the event or initiate any action to change the reporting procedure to address facility-specific conditions, including their radiological posting protocols. The facility subsequently reported the event and is reviewing methods to tailor facility protocols such that they meet all applicable occurrence reporting requirements (see Findings #3 and #4).

During this same event, health and safety personnel failed to post Room 1010 as a contamination area after discovery of removable contamination that exceeded applicable criteria, as required by the ES&H Manual and DOE regulations. When advised of this concern, the area was subsequently posted as a contamination area. Following re-entry to this area, a hazard control technician (HCT) did not follow the requirements of the contamination area posting. An HCT exited the contamination area without performing a whole-body frisk as required by the posting. That HCT, along with another HCT and two supervisors, stated that a whole-body frisk would not be required based on FSP rules. After pointing out the contamination area posting, the workers and supervisors recognized that a whole-body frisk was required (see Finding #3).

In addition to the failures associated with the October 19, 2004, glove failure, OA observed several other examples of failure to follow established safety rules or requirements (see Findings #3 and #4):

- The ES&H Manual requires ground fault interruption protection on circuits powering electrical tools used in unsafe or damp environments. OSPs for several operations in Building 332 reference electrical hazards and state that all ES&H Manual requirements will be followed to control these hazards. However, neither the responsible individuals for some laboratories nor the facility engineering staff have ensured that ES&H Manual requirements are followed for ground fault circuit interruption (GFCI) protection. For example, gloveboxes in Room 1378 have electrical outlets used to energize portable electric tools and equipment. These gloveboxes contain damp environments, have plumbed water supplies, and use acids and bases; however, the responsible individuals and facility engineers have not ensured that portable electrical equipment is protected by GFCI protection. Although many circuits have been in service for years, recent modifications have also not addressed the ES&H Manual requirements. For example, a breaker panel in Room 1378 was replaced in 2001 to add more power for an oxide washer, but the modification did not include GFCI protection.

- In one laboratory, fissile material handlers did not specifically follow an FSP safety rule that states, "After working in a glovebox or fume hood, workers shall survey their arms and torso before leaving the workstation." A fissile material handler left the room without performing the required survey, and another worker left the workstation (but remained in the room) without performing the required survey. When personnel in the room were questioned, one fissile material handler stated that the rule only applied when the worker intended to leave the RMA. Another worker stated that the rule only applied when leaving the room. The workers, the workers' supervisor, and workers in other laboratories indicated that it was general practice not to do the survey when leaving the workstation but staying in the room. A contributing factor to this failure is that the FSP specifies a less stringent requirement for this frisk (perform prior to leaving the room) in a different section of the FSP, and labels on facility hand and foot monitors remind workers of the less stringent requirement.

- In a few cases, personnel did not perform sufficient hand and foot checks when exiting RMA laboratories. For example, some personnel did not place their entire foot over the detector and/or monitored only one hand because they were carrying something in the other hand.

Summary. Many work evolutions are appropriately authorized and performed safely in accordance with established controls. However, OA observed a number of examples of failure to follow established safety rules or requirements, and in some cases, management tolerated non-conservative interpretations of safety requirements without initiating appropriate corrective actions. Additional management attention is needed in this area to ensure a culture in which supervision and workers either follow safety requirements as written or stop the work activity until the requirements are corrected.

C.2.2 Physics and Advanced Technologies Directorate Research and Development

The PAT Directorate performs research in a wide variety of areas, including condensed matter and high-pressure physics, optical science, medical physics and biophysics, nuclear particle and accelerator physics, high-energy physics, fusion energy research, laser science, and geophysics and planetary physics. To perform this expanse of research, the PAT Directorate employs nearly 500 employees, as well as researchers, post-doctoral students, and graduate and undergraduate students on short-term internships.

Potential hazards within the PAT Directorate are diverse and include non-ionizing radiation (such as laser devices), high-voltage electrical equipment, ionizing radiation from radioactive materials, X-ray producing equipment, fusion devices and accelerators, hazardous chemicals, magnetic fields, energetic materials and explosives, biological agents, and mechanical hazards. Research is conducted in over 20 buildings and a number of offsite locations. ES&H support is provided to the PAT Directorate through LLNL ES&H Team 3. The PAT Directorate has also established a three-person dedicated Safety Support Office to manage and direct the ES&H resources to the appropriate research activity.

OA's evaluation of implementation of the first four core functions of ISM for PAT research focused on evaluation and sampling of safety performance across four of the eight PAT divisions. PAT research work observed by OA included operation and program maintenance of the 100 MeV Electron-Positron LINAC accelerator and the Electron Beam Ion Trap in Building 194; research, operation, and maintenance of the two-stage gas gun in Building 341; biomedical device testing being performed in the Medical Physics and Biophysics Division in Building 132S; and research conducted in the Building 272

X-ray Laboratory and Deposition (Magnetic Sputtering) Lab operated within the Optical Science and Technology Division. IWSs and related work documents, facility-level safety plans, ES&H policies and procedures, laboratory spaces, and administrative and engineering controls were also sampled and evaluated.

Core Function #1: Define the Scope of Work

The LLNL ES&H Manual describes the overall work control and ISM processes that apply to research activities and experiments conducted within the PAT Directorate. For research activities at LLNL, defining the work includes defining the scope of work, identifying the work authorization chain, identifying the location of the work, and establishing the resources and priorities to perform the work.

Overall, most work activities at the experimental level are well defined in IWSs, FSPs, safety plans, or OSPs such that hazards can be identified and controls can be developed. For example, the work scope for the Electron Beam Ion Trap experiment is detailed and documented in a combination IWS/safety plan that is logical and understandable. Similarly, the combination IWS/safety plan for the two-stage gas gun experiments is detailed, easy to read, and provides sufficient information concerning the scope of the activity. The analytical X-ray research conducted in Building 272 is well described in an appendix to the IWS for this activity.

The definition of work for research with the potential for higher hazards is further augmented by work descriptions in facility-level safety documents. For example, research conducted at the LINAC accelerator is described at both the research activity level though an IWS and safety plans, and at the facility level though a safety assessment document and an FSP. Research conducted at the two-stage gas gun in Building 341 is described at the research level through IWSs, safety plans, and engineering safety notes, and at the facility level through an FSP and a hazards assessment document. In general, these documents collectively adequately address the scope of most work conducted within these facilities.

Summary. Work scopes as defined in an IWS, safety plans, or facility-level hazards documents generally provide an adequate description of work such that hazards can be identified and controls can be developed.

Core Function #2: Analyze the Hazards

The formal hazard identification and control process for research activities within the PAT Directorate focuses primarily on the IWS and safety plan at the research activity level, and FSPs, safety assessment documents, and hazards analysis reports at the facility level, for higher hazard research activities. The informal hazard identification and analysis process is the daily interchange of ideas and discussion of hazards among researchers, responsible individuals and their group lead, the affected facility managers, the PAT safety officers, and the ES&H subject matter experts from ES&H Team 3.

Most researchers within the PAT Directorate are knowledgeable of the hazards associated with their research as a result of extensive ES&H training and years of experience and expertise in identifying and controlling hazards within their areas of research. For example, researchers and engineering technicians associated with the two-stage gas gun operation were knowledgeable of the hazards of materials and the equipment with which they routinely work. The research staff for the Analytical X-Ray Laboratory in Building 272 was knowledgeable of the equipment operation, hazards, and controls. The Electron Beam Ion Trap researchers were knowledgeable of both the operation of the apparatus, the concepts of the experiment, the hazards, and potential accident scenarios.

The PAT Directorate has also been proactive in improving and implementing institutional safety programs that impact the identification, mitigation, and control of research-related hazards. For example, the PAT Directorate has been proactive, aggressive, and effective in identifying and resolving ergonomic hazards. Over half of the recordable injuries within the PAT Directorate are ergonomic-related. During the past year, ergonomic evaluations were conducted on most office spaces and many work areas within the PAT Directorate. Of the 150 PAT employees interviewed by the ergonomics review team, 84 were identified as being at risk for developing potential ergonomic injuries, and intervention actions were initiated. Such mechanisms as a "key move" list, building sweeps, and facility point of contact (FPOC) reviews have been established within the PAT Directorate to aid in identifying ergonomic risks. In another example, the PAT Safety Office has been instrumental in prototyping and designing improvements to the LLNL IWS process that have improved the capabilities for identifying, analyzing, and controlling research-related hazards.

Although most hazards associated with research activities are adequately described in IWSs and safety plans, in four cases, experimental or facility hazards have not been adequately identified, analyzed, and/or documented. These four cases are symptomatic of deficiencies in implementing the work control process.

In the first case, the lead hazards description in the Electron Beam Ion Trap IWS indicates that the lead shielding is "enclosed in two layers of aluminum." However, much of the lead available for use with the Electron Beam Ion Trap experiment is temporary shielding in the form of lead bricks, a number of which are not encapsulated. The potential hazards and controls for the use, storage, and movement of lead bricks were not addressed in the IWS. Although the Building 194 FSP addresses controls for handling lead in general, not identifying the lead brick hazard in the IWS could result in the appropriate controls being missed (see Finding #1).

In a second case, the potential exposure hazards from metal grinding, cutting, polishing, and soldering or brazing work activities in the Building 341 machine shop have not been identified, evaluated, and/or documented in an IWS. Similarly, the most recent IWS for the Building 194 machine shop (May 2000) is not current, and does not adequately describe the hazards associated with similar activities in the Building 194 machine shop. The Building 194 FSP provides a description of physical hazards and some controls for machine shop operations, but the hazards and controls identified in the FSP are not integrated into the IWS, nor does the FSP identify all of the hazardous operations in the machine shop. Similarly, machining hazard and control information is documented in a 1999 industrial hygiene memorandum; however, these hazards and controls have not been incorporated into this IWS directly or by reference. A description of some hazards and controls for work performed in the Building 341 machine shop is addressed in the Building 341 FSP, but there is no IWS for working in the Building 341 machine shop. Furthermore, Document 2.2 of the ES&H Manual has no provision for using an FSP to define work-activity hazards and controls in lieu of issuing an IWS. Deficiencies in PAT machine shops were also self-identified in the 2003 PAT Directorate ES&H Performance Report (see Findings #1 and #4).

In a third case, the potential hazards from exposure to magnetic fields when servicing the larger magnetron sputtering tool in Building 272 has not been formally evaluated, and controls (such as warning signs) may have been missed. The 12 Gauss contact exposure with the magnets is greater than the 5 Gauss threshold stated in Document 20.7 of the ES&H Manual, which requires the posting of caution signs (see Finding #1).

In a fourth case, the potential hazards associated with an inadvertent discharge of the carbon dioxide (CO_2) fire suppression systems during inspections of the radio frequency modulators in Building 194 had not been formally analyzed or documented prior to the OA team visit. The FSP requires the CO_2 system to be locked out for maintenance activities performed within the modulator cabinets, because CO_2 concentrations within the cabinets can rapidly deplete oxygen levels to lethal concentrations (10 percent oxygen or less). However, an analysis had not been conducted of the concentrations of CO_2 external to the cabinet during routine inspections when modulator cabinet doors were open and the CO_2 system was not locked out (e.g., which was noted during the OA scoping visit). A recent calculation performed by the ES&H Team 3 industrial hygienist concluded that oxygen levels for inspectors near the modulator cabinets resulting from an inadvertent CO_2 discharge could be reduced to 17.3 percent. The Occupational Safety and Health Administration (OSHA) defines an oxygen deficient atmosphere as one with an oxygen level less than 19.5 percent, and a National Institute for Occupational Safety and Health (NIOSH)-recommended standard discusses a 16 percent oxygen level as a limit that is immediately dangerous to life or health (see Finding #1).

Summary. Overall, researchers and technicians are well aware of the hazards associated with their activities and experiments, and most IWSs have adequately identified the hazards associated with research activities in the PAT Directorate. However, several hazards were identified during this evaluation that have not been sufficiently analyzed and/or documented, and as a result some controls may have been missed.

Core Function #3: Identify and Implement Controls

The ISM work process at LLNL, as described in Document 2.2 of the LLNL ES&H Manual, provides clear expectations for developing and implementing hazard controls for research activities. At the institutional level, the ES&H Manual establishes the controls for implementing the ES&H safety standards and requirements identified in the LLNL Work Smart Standards. At the facility and research activity levels a hierarchy of engineered, administrative, and personal protective controls are to be implemented if the hazard cannot be eliminated or reduced by revising the design of the activity.

For the PAT Directorate facilities and research activities observed by the OA team, experimental and facility safety equipment was either in good working condition or tagged out appropriately. Engineered safety controls at the PAT facilities are well maintained and include building and local ventilation systems, door and equipment interlocks, and engineered structures to reduce radiation levels or to prevent injury or property damage in the event of a mishap. Preventive and corrective maintenance is routinely performed by dedicated engineering technicians on such equipment as the two-stage gas gun, the LINAC accelerator, and the magnetron sputtering tool to ensure that the equipment is maintained in safe operating condition and working properly. In Building 194, one day each week is dedicated to maintenance activities for equipment and facilities. Safety interlock systems for the LINAC, laser systems, and the two-stage gas gun are tested on a regular basis. Observation of the semi-annual safety interlock system for the LINAC indicated that the interlock tests were performed successfully and in accordance with the interlock test procedure. The research equipment and safety interlock system for the X-ray analytical equipment in Building 272 was well maintained. The Chemical/Biological Safety Discipline Action Plan for the PAT Directorate is an effective tool for defining the requirements and instructions for ensuring that worker exposures are monitored on a risk-based frequency, and that engineered controls (e.g., local ventilation systems) are tested on an appropriate frequency.

Completion of an operator training and qualification program is often required to operate research equipment that is complex and/or presents a higher risk of potential injury to the researcher. Although the training and qualification program lacks consistency across experiments, the operator training and qualification process is generally well structured, thorough, and effective. For example, selection, training, and qualification of gun operators for the two-stage gas gun in Building 341 is extensive and often requires operators to undergo more than a year of training and mentoring prior to being authorized as a gun operator. The training and qualification program for LINAC operators is also extensive and well documented in operator training lesson plans. To operate the Electron Beam Ion Trap, researchers must have become qualified on equipment operation though formal training and mentoring by the responsible individual. PAT machine shop users are also required to complete a mentoring training and proficiency evaluation from the shop supervisor to ensure that they are familiar with the equipment and hazards of operating the equipment.

Although engineered safety controls in facilities and research equipment are well maintained, and operators and researchers are typically well trained and qualified, the OA team identified several process and performance weaknesses as described in the following paragraphs.

If the research is a complex work activity with the potential for significant hazards and/or more complex hazard controls and equipment, the IWS/safety plan will often be supplemented by one or more work documents (e.g., procedures, checklists, or operator aids). For example, although the hazards and controls for operation of the two-stage gas guns in Building 341 are described in the IWS/safety plan for the gas guns, a fifteen-page pre-shot data sheet/checklist is used to describe the steps for preparing, testing, and firing the guns, and gun re-entry. In other cases, such as the Electron Beam Ion Trap, special procedures, such as the *Procedure for Installing a Toxic Material on the Gas Injector,* are developed for the infrequent handling of some toxic gases. In general, these work documents (i.e., procedures, checklists, and operator aids) are not well integrated into the IWS process, and some work documents do not meet the requirements of ES&H Manual Document 3.4, *Preparation of Work Documents*. For example, the aforementioned pre-shot data sheet and checklist used for the gas gun firing lacks a procedure identifier and concurrence and approval signatures as required by ES&H Manual Document 3.4. Toxic gas procedures associated with Electron Beam Ion Trap experiments also lack these required elements. In addition, most PAT work documents lack one or more of the elements recommended in a work document as described in ES&H Document 3.4, such as a description of the purpose, scope, definitions, responsibilities, revision status, or the procedure itself. Often, there is no record that an ES&H team review was required and/or performed when developing or revising these work documents. Neither the Electron Beam Ion Trap toxic gas procedures nor the gas gun pre-shot data sheets are identified or referenced in the associated IWSs, nor is use of or familiarity with these procedures identified in the IWS as a requirement. Because these documents do not indicate names or signatures of reviewers/approvers, it is not clear whether the documents were approved for use by either a responsible individual or an authorizing individual. Although ES&H Manual Document 3.4 provides some guidance regarding the content, development, review, and approval of work documents, there are few mandatory requirements. Furthermore, the PAT Directorate has not established clear policies and guidance on how technical and operating procedures/checklists that support an activity described in an IWS are to be reviewed, revised, approved, or incorporated into the IWS process. As a result, the content and review of these work documents varies considerably among responsible individuals within the PAT Directorate (see Findings #1 and #2).

In some cases, the OA team observed that hazard controls for a research activity were not adequately identified or described in the IWS, safety plan, FSP, or work documents. For example, one statement in the *Pre-shot Data Sheet for the Gas Gun* is to "center and align the target." However, to complete this step, the X-ray equipment associated with the gas gun must be operated. Administrative safety controls associated with operating the X-ray equipment include an announcement that the X-ray equipment is to be operated, a sweep of the building to ensure that there are no occupants before using the X-ray machine, and a closure of the door leading into the chamber prior to the operation of the X-ray machine. These precautions, while of general knowledge to the operators, are not documented in the checklist, IWS, or safety plan. ES&H Document 3.4 recommends that safety considerations, such as cautions and warnings, be discussed within the work document. In several cases, hazard controls are not adequately described in the IWS/safety plan as a result of using extensive cross referencing within the IWS. For example, the IWS for the two-stage light-gas gun system identifies numerous types of hazards, and refers to the attached safety plan for a description of both the hazard and appropriate controls. However, in a number of cases, neither the hazard nor the controls are in the safety plan as indicated in the IWS (e.g., carcinogens, mutagens, or reproductive hazards). ES&H Document 2.2, *Managing ES&H for LLNL Work*, requires the responsible individual to ensure that applicable controls are identified for each hazard associated with the work and described through the IWS/safety plan process (see Findings #1 and #2).

In some cases, routine operations or program maintenance activities for some research equipment are not described in an IWS, although there are identified hazards and required controls associated with the activity. For example, although there are potential hazards and expected hazard controls associated with operating the lathes, drill presses, and saws in the machine shop in Building 341, the operation of this equipment is not addressed in an IWS. Without an IWS, hazard controls are likely to be missed. To illustrate, in the case of the Building 341 machine shop, the local exhaust from the soldering bench has not been routinely tested, because neither the hazard nor exhaust system control was identified in an IWS, and therefore the opportunity to include the annual ventilation testing requirement in the Chemical/Biological Safety Discipline Action Plan was missed. Similarly, without an IWS, the hazards and controls associated with machining certain metals may be missed, as previously discussed in Core Function #2 (see Finding #1).

In another example, the program maintenance activities for the two-stage gas gun are documented in a series of maintenance procedures. However, there is no reference to these procedures in the two-stage gas gun IWS, and the maintenance-related hazards and controls in the gas-gun IWS cannot be clearly linked to the maintenance procedures (see Findings #1 and #2).

In general, ES&H training requirements identified in PAT Directorate IWSs are not sufficiently defined to ensure that the compulsory training requirements are distinguished from recommended training. Most IWSs within the PAT Directorate identify all training as “Required ES&H Training.” However, when the research work is performed, participants may be deficient in several of the training requirements because the training requirement was perceived by the responsible individual to be recommended (not required), or because the training was not required for the current phase of the research activity. However, the IWS typically does not provide this level of distinction. As a result, researchers may not have completed all of the required ES&H training identified in an IWS prior to conducting work. For example, one researcher working on the magnetron sputtering tool in Building 272 had not completed 40 percent of the “Required ES&H Training” identified on the IWS, including training courses on ergonomics, safety bases, cranes, and confined spaces. In addition, for some IWSs, training requirements are identified in the IWS (e.g., in the laser training section) but are not identified in the “Required ES&H Training” section of the IWS. Because changing conditions, hazards, and controls are inherent in experimental research, one of the most important hazard controls is a clear identification of training and qualification requirements (see Findings #1 and #4).

A few inconsistencies were also identified with the FSPs for PAT buildings with respect to the description of hazards and hazard controls. For example, the Electron Beam Ion Trap apparatus and associated hazards and controls, although addressed in the safety assessment document for Building 194, are not addressed in the FSP for Building 194. However, the hazards and controls of other Work Authorization Level C activities within Building 194, such as the LINAC and Pelletron, are described in the Building 194 FSP. Section 2.1 of ES&H Manual Document 3.3 indicates that a purpose of the FSP is to "outline the methods for controlling and minimizing the ES&H hazards and risks identified in safety basis reports," such as the safety assessment document. In another example, the Building 194 FSP lacks clear and unambiguous guidance concerning the storage, moving, posting, and surveying for materials that potentially were activated by the LINAC accelerator. Although institutional guidance for the disposition of activated materials is provided in Document 20.2 of the ES&H Manual, *LLNL Radiological Safety Programs for Radioactive Materials,* the practices for implementing this guidance in Building 194 are not defined in the Building 194 FSP, or in any other document (see Findings #1 and #2).

Summary. Engineered controls for research equipment within the PAT Directorate are extensive and well maintained. Equipment operator training and qualification programs are commensurate with the complexity and hazards of the research equipment. Administrative controls and PPE requirements are sufficiently described in most IWSs, safety plans, and facility-level safety documents, such as FSPs, safety assessment documents, and hazards analyses reports.

However, improvements are needed in some IWSs and safety plans to clearly identify all hazard controls for a research activity and adequately link those controls to the hazards for which they are intended. In addition, the format, content, review, approval, and revision process for work documents (i.e., procedures and checklists) is not adequately defined in a procedure or work instruction, and some PAT procedures and/or checklists do not meet the minimum requirements for work documents as described in Document 3.4 of the ES&H Manual. Attention is also needed for those routine operations and maintenance activities that are not commonly performed by the public, to verify that hazards and controls are adequately documented in an IWS or safety plan. Improvements are also needed in the specification of ES&H training requirements, to ensure that researchers are clear as to the distinction between required training, recommended training, or hazard-specific training.

Core Function #4: Perform Work Within Controls

In most cases, research activities observed by the OA team within the PAT Directorate were conducted safely, using the appropriate engineering and administrative controls and PPE.

As a result of an aggressive injury and illness prevention program, the PAT Directorate has maintained a safe research environment, as evidenced by a low incidence of injuries and illness. During the past few years, PAT's injury and illness rates and lost/restricted days were among the lowest of all LLNL directorates. In calendar year (CY) 2003, the PAT Directorate incurred 3 recordable injury cases (2 of which were ergonomics-related), 3 first aid cases, 18 lost/restricted work days (all ergonomics-related), and an overall Injury Cost Index of 3.82. For CY 2004 (through August), and with over 450,000 work hours, the PAT Directorate has no recordable injury cases, 1 first aid case, and no lost/restricted days. The safe research environment within the PAT Directorate can be attributed to a research staff that is knowledgeable of the hazards and controls, line management emphasis on performing work safely and within established controls, and the implementation of a directorate safety support office during the past three years.

The PAT Safety Support Office has been instrumental in identifying and directing safety support to the PAT research staff. Although the three-person PAT Safety Support Office is affiliated with ES&H Team 3, the office is dedicated to the PAT Directorate and is tasked directly by the PAT Assistant Director for Operations. The PAT Safety Support Office has been effective in focusing on initiatives to reduce injuries and illnesses, although the primary work of the office is to assist the research staff in identifying, eliminating, or controlling hazards and in implementing the IWS process. In addition, the PAT Safety Support Office conducts audits, maintains the safety deficiency tracking system, and provides independent review of safety basis documentation for the directorate.

Although the PAT safety record is admirable, the OA team identified instances where safety procedures/processes were not followed. These instances are discussed below and indicate that, like other LLNL organizations, the PAT Directorate needs to focus more on adherence to work instructions.

In a few cases, safety requirements identified in IWSs and technical documents are not being followed as written. For example, during the most recent health physics survey conducted on the X-ray Analytical Unit in Building 272, the survey was not conducted when the machine was operating in the worst case configuration (i.e., with all non-interlocked covers in the open position) as required by the radiological survey form. One non-interlocked shield was left intact during the survey, which was a failure to follow the requirements identified on the radiological survey form. In another example, the HP-DAP for Building 194 contained a pen and ink change requiring a monthly survey of outdoor areas. However, the survey frequency was being implemented only semi-annually, based on verbal instructions from the health physicist, rather than following or correcting the written requirement if it was incorrect (see Finding #3).

In one case, requirements for authorizing work were not followed, resulting in a situation where work authorization was granted prior to implementation or verification of completion of all the necessary safety controls and/or safety evaluations. In this example, work authorization for two magnetrons in Building 272 was issued on September 24, 2004, when the authorizing individual approved the IWS. However, final inspection and completion of the industrial hygiene evaluations of the second and larger magnetron had not been completed at the time of work authorization. For example, the magnetic field survey, pre-start inspection, and confined space evaluation and postings (if required) for the larger magnetron had not been completed at the time of work authorization. Furthermore, at least one of the researchers designated in the IWS had not completed all of the ES&H-required training prior to the authorizing individual approving the IWS. Section 3.3 of ES&H Manual Document 2.2 states that the "authorizing individual…ensures that the IWS and any required documentation has been completed, and the controls confirmed to be in place…before authorizing the work activity" (see Finding #3).

Summary. In general, the excellent safety record within the PAT Directorate is indicative that research work is performed safely and within the controls established. However, opportunities for improvement were also identified with respect to following safety procedures, and in ensuring that all hazards are evaluated and that controls are in place and verified by the authorizing individual prior to authorizing work.

C.2.3 Maintenance

Maintenance of real property and installed equipment at LLNL is conducted by the Plant Engineering Department. The Maintenance Production Division performs the bulk of the work through the use of preventive maintenance task codes, job orders (Form 1 requests), and "whiz" tags. Preventive maintenance is scheduled on an annual basis, and in some cases is collected into a maintenance windowing program to minimize program impact and more efficiently use available resources. Job orders are larger jobs requiring more than 32 hours to complete, more than one craft, or other more detailed coordination and planning. Whiz tags are work requests that can be completed by a single craft, in less than 32 hours, with no long lead materials or detailed coordination. In fiscal year (FY) 2004, the

Maintenance Production Division completed 1,634 job orders using 572,159 labor hours; 36,966 whiz tags using 275,520 labor hours; and 15,251 preventive maintenance tasks using 39,274 labor hours.

ISM is primarily implemented through IWSs, safety plans, bridging documents, and pre-task hazards analyses. Plant Engineering has 46 trade/service IWSs that are used to broadly analyze the different craft and shop work routinely performed in connection with maintenance. The bridging documents are then used to connect the trade/service IWS to the specific facility hazards and task associated with an individual work request. This system is described and implemented through a series of maintenance operating procedures, which are derived from and reference LLNL policies and standards.

This inspection focused on all types of work performed by the Maintenance Production Division, from simple jobs, such as whiz tags, to preventive maintenance, and a complex urgent task to provide temporary power to Building 132, which involved installing a 2000 kVA temporary substation between a 13.8 kV high-voltage feeder line and a 480 V main distribution panel through temporary cables. Other tasks observed included building ventilation system preventive maintenance, building electrical distribution system modifications, and roof access preparations.

Core Function #1: Define the Scope of Work

For whiz tag and job order maintenance requests, the work is primarily defined by the customer. These work definitions tend to be rather short, and accuracy and detail vary depending on the expectations of the supervisors and workers. Work orders for larger jobs may contain more detailed work descriptions. Additional clarification is often sought from the FPOC. In many cases, craft personnel visit the job site and perform a walkdown to fully understand the scope of work. For whiz tags, this walkdown is normally conducted by the craft person who will actually perform the work. Additional details from this walkdown are not normally documented in the work request.

In one case, inadequate definition of the work to be performed contributed to a worker violating the laboratory electrical safety policy. In this case, an electrician was assigned a whiz tag to change a raised electrical socket in the floor of an office to a flush mounted socket. The worker was performing a walkdown, and in the course of that walkdown, decided he needed to remove the faceplate of the socket. According to LLNL policy, such a removal would require a lockout/tagout on the affected circuit. The worker did not use a lockout/tagout. He was stopped before the cover plate was removed. However, failure to clearly define the scope of the assigned task directly contributed to his actions.

Preventive maintenance task codes are further detailed, but in some cases are not tailored for specific equipment installations. The task codes are identified by equipment number and location, but the series of maintenance tasks to be conducted under a specific code are sometimes generic, and the workers performing the preventive maintenance must pick and choose from the listed tasks. This approach has the unintended consequence of acclimating workers to picking and choosing the procedural steps they believe are applicable, a behavior that contributes to deficiencies in procedure adherence, as discussed under Core Function #4.

Work scopes for work performed by the NIF work team were clearly defined, and the NIF work team has implemented supplemental processes that ensure that work is clearly defined (the task identification process list). These supplemental processes are not defined within any work control process instruction or the NIF Project Site Safety Program.

Summary. Most work definitions were adequate, but in some cases, written work definitions were not always detailed enough for anyone other than the specific craft worker performing the job walkdown to perform effective hazard identification and analysis. This limits effective participation by ES&H professionals in the subsequent hazard identification and analyses.

Core Function #2: Analyze the Hazards

The Plant Engineering maintenance management system follows the LLNL ISM system description document, which defines three levels of work authorization, and ties the required hazards analysis to that work authorization level. Work Authorization Level A is the simplest, and consists of those tasks that would normally be conducted by the general public. Level A requires no supplemental hazards analysis. Level B is more complex and requires an IWS. Level C is the most complex, involves special hazards, and requires an IWS in connection with a facility or site safety plan. For most Plant Engineering work, Level B applies and, in some cases, the work would be considered Level C. A potential fundamental problem with this approach is that the work authorization level determines the degree of hazards analysis, rather than the hazards analysis determining the appropriate work authorization. While no specific examples were observed where this situation led to a problem on this inspection, the potential for misclassifying hazardous activities exists.

The IWS is the primary means of hazard identification and analysis. It is structured to identify discreet tasks, determine the hazards associated with that task, and then identify the controls necessary to minimize or eliminate the hazards. The IWS then becomes the central document for implementing ISM. Plant Engineering relies primarily on a set of service/trade IWSs for the performance of most work. These IWSs are very general discussions of the potential hazards, do not link directly to tasks being performed for specific jobs, and do not always identify the specific controls (see Core Function #3 for further discussion of controls). Consequently, for most work performed by the Maintenance Production Division, there was little or no task-specific hazards analysis performed (see Finding #1).

The maintenance management system allows a task-specific IWS to be prepared. The NIF Project/Directorate has ensured that IWSs for work performed within the NIF project are specific and detailed. Consequently, for Plant Engineering support at NIF, the IWSs reviewed by the OA team are very detailed and clearly link specific work tasks to primary hazards encountered during the task.

Bridging documents are used to tie service/trade IWSs to specific work requests. These bridging documents also provide a means to document work authorization by the FPOC. The bridging document is intended to better clarify specific hazards associated with the facility in which work is to be performed. The customer must answer five general questions related to the facility-specific hazards and can reference any applicable facility IWSs or safety plans. Bridging documents reviewed during this assessment did not contain specific hazard information, but only identified facility-specific IWSs by number.

Pre-task hazards analysis sheets are used by all workers on a daily basis and are intended to act as a reminder for workers to review the hazards encountered during the work and the controls necessary to address those hazards. In general, these sheets are not detailed and have limited value as a hazards analysis tool. While workers demonstrated a high level of attention to hazards and the many hazard controls were discussed in detail, decisions regarding hazard controls are not documented on either an IWS form or a pre-task hazards analysis. This lack of documentation was particularly evident during the Building 132 temporary power installation. Although this job involved a number of hazards, including high voltages (13.8 KV), no job-specific IWS was prepared. The lack of documentation for the detailed plans that were verbally discussed results in a lack of defense-in-depth for implementation of hazard controls and makes it impossible for supervisory personnel to verify that the agreed-upon controls were in place when necessary (see Findings #1 and #2).

In contrast to the rest of the Maintenance Production Division, pre-task hazards analysis used by the NIF work team are more detailed and include specific controls, and are effective in ensuring that workers review requirements of the IWS prior to beginning work.

The lack of detailed hazards analysis through an IWS, bridging documents, and preliminary hazards analyses (PHAs) results in a heavy dependence on individual craft knowledge of the hazards, and has resulted in some hazards not being adequately addressed during the course of work. For example, during the conduct of preventive maintenance in Building 311, the potential for workers in the penthouse and ventilation plenums to be unaware of a building emergency was not identified in the applicable documents. The individual worker observed had a means of listening to the plant's fire radio channel, but the lack of a detailed hazards analysis resulted in inadequate controls to ensure accountability. In another example, the material safety data sheet (MSDS) for grout was not referenced in preparing the IWS or PHA for grouting work. The MSDS specifically identified silica as a potential carcinogen, and recommended showering after use. In this case, the incomplete hazards analysis led to failure to identify adequate controls prior to performing the work. Similarly, a potential for eye injury during fan maintenance on Building 253 was not identified, and the worker was not wearing safety glasses when inspecting a running fan after installation of a new drive belt (see Findings #1 and #2).

Summary. Hazards analyses performed in connection with IWS have been limited, and the broad use of generic IWSs rather than use of task-specific IWSs results in an overreliance on individual worker knowledge and skill. Some hazards are subsequently not identified or analyzed. Significant management attention is required to ensure stricter compliance with laboratory expectations for use of the IWS system.

Core Function #3: Identify and Implement Controls

Workers have a variety of controls that can be applied during conduct of maintenance work. Controls include lockout/tagout, roof access permits, confined space permits, low-voltage outage permits, soil excavation and penetration permits, respirators and other PPE and clothing, and fall protection.

The controls implemented for soil excavation and floor penetrations are effective in minimizing and preventing utility strikes. LLNL has devoted significant time and effort to clearly documenting identified utilities prior to digging or penetrating, and personnel are clearly cognizant of the need for diligence. Many aspects of the excavation permit process could be considered a noteworthy practice (see Appendix D).

Overall, the process for coordinating and controlling low-voltage outage work is an effective control for tracking changes to building electrical systems. The process is governed by a procedure (MOP–16003) and controls modifications to the building electrical systems. Work may not proceed until the permit application has been reviewed and approved by the Technical Administration Group. One potential procedural weakness is that the informal reviews of the proposed work conducted by the Technical Administration Group are not officially part of the permit process.

Controls identified in IWSs for the NIF work team are detailed and specific, and can be readily tied to specific work steps or actions. However, controls identified in most other maintenance IWSs or PHAs are not specific and rely primarily on worker awareness of the hazards to ensure that controls are effectively implemented. In some cases, controls identified in the ES&H Manual, MSDSs, or other sources are not effectively included in the IWS. For example, ES&H Manual Document 16.3 requires that "Authority Having Jurisdiction personnel SHALL review and approve electrical equipment, installations, and work at LLNL." As previously discussed, electrical modifications performed using whiz tags are subject to controls that ensure that changes are documented on panel schedules, but the final installation is not subjected to an acceptance inspection by a designated electrical inspector to ensure that the installation meets code requirements, and the need for that inspection has not been included in any applicable work requests covering electrical modification work (see Finding #3).

IWSs typically identify PPE as a necessary control, but do not specify exactly which PPE and under what conditions it is required. For example, some IWSs refer to respirators, but do not specify which type of respirator, and do not require an industrial hygiene assessment to verify that the correct respirator is being used. Another common reference is to gloves, but the type of gloves (leather, surgical, cotton, rubber, electrical) is not specified. Instead, the specific PPE to be used is determined by the worker at the time of work (see Findings #2 and #4).

Another example of failure to adequately identify and implement controls was observed in Building 253. While preparing a roof access permit for preventive maintenance work, the mechanic was inspecting each of the hoods in the building with the FPOC. During that inspection, it was noted that an open vial marked "Pu/Am" was in the hood in Laboratory 1722A. The mechanic questioned whether that vial should be removed from the hood. No one reviewed the facility IWS or FSP to determine the appropriate controls. A memo was found outside Laboratory 1722A with the laboratory IWS. That memo, addressed to Plant Engineering, discussed hoods that could continue to operate during roof access. According to that memo, the hood in Laboratory 1722A is required to "Terminate Ops" during roof access, but contained no clear definition of expected actions. Thus, the control was not clearly specified, and the need for the control was not adequately communicated to the mechanics performing the work (see Findings #2 and #4).

Summary. The broad use of generic IWSs for the performance of work results in a system where workers must decide which controls they believe are applicable, rather than following a pre-determined, authoritative set of controls that must be implemented prior to performing work. Significant management attention is required to assure that effective controls are clearly identified to the worker prior to authorizing work. The work observed at NIF indicates that attention by managers and supervisors to the details of implementing the laboratory's defined ISM system can and will significantly improve the quality of written instructions provided to workers.

Core Function #4: Perform Work Within Controls

Switching operations by the Electric Utilities Division during the course of maintenance at Building 132 were conducted in a stepwise, controlled fashion, with good attention to detail. The division regularly uses stepwise switching plans (procedures) to control changes and realignments of the plant high-voltage electrical system. The procedures were developed, reviewed, and approved before any switching operations began. At one point, when there was confusion over the specific switch to operate, the operation was suspended in a safe configuration while the confusion was addressed, and then continued after all involved personnel were satisfied.

With one exception, conduct of electrical maintenance activities was performed following good electrical safety practices, including use of flame retardant clothing, electrical flash face shields, lock and tag and zero energy checks, grounding of conductors, use of backup personnel, and construction barriers. Given the lack of specificity of controls identified in the IWS, PHA, or other work documents, LLNL relies very heavily on individual expertise at the time of work to prevent injury or exposure to hazards. In all the examples reviewed, no identified hazard controls were missed, although in some cases the need for the control was not identified until the last minute. In one case, the reliance on individual expertise and judgment led to a worker violating the electrical safety policy delineated in the ES&H Manual. As previously discussed in Core Function #1, an electrician working on a request to change an existing raised electrical outlet in the floor to a flat electrical outlet violated the plant electrical safety requirements. The whiz tag did not identify any lockout/tagout requirements, nor did it contain any provisions for working on energized gear. The ES&H Manual, Volume 2, Section 16.1, specifically prohibits working on electrical gear while it is energized. If the equipment must be worked on while it is energized, an OSP must be used, as well as appropriate PPE. The worker in this case began removing the cover plate for the outlet without locking out the applicable circuit breaker. When asked if he was allowed to remove the cover plate exposing live conductors, he replied that he was allowed to remove the cover plate without lockout/tagout while conducting trouble shooting and repair. After further consideration, and without removing the cover plate, he put the screw back in the cover plate and stopped working on that request. The ES&H Manual does not make an exception for trouble shooting and repair without additional precautions (see Finding #3).

As mentioned under Core Function #1, preventive maintenance task codes are written in a generic manner and include a list of several tasks; a generic code is then assigned to all equipment that fits that class of equipment. The specific task list is not tailored to the individual piece of equipment being serviced. Consequently, the technician performing the work must pick and choose, based on his or her individual knowledge, those tasks that are applicable to the specific equipment. This practice, in effect, acclimates craft personnel to only selectively following procedures, rather than insisting that procedures are correct (see Finding #4).

There are many different signs, barriers, and other postings used across the plant site, particularly related to maintenance activities. In some cases, it appears that plant personnel are becoming desensitized to these controls. Many non-maintenance personnel, without hard hats, safety shoes, or safety glasses, routinely crossed construction barriers without permission or regard to the work going on inside the delineated area. Signs indicating hearing protection and eye protection areas in the maintenance shop areas were ignored by shop personnel (see Finding #3).

Summary. With one exception, all work observed was conducted in accordance with controls identified for the task. There were some cases where procedures (maintenance task codes) could not be performed as written, and workers accepted the deficient procedure and performed those portions of the procedure that they believed were applicable, rather than stopping and correcting the problem with the procedure. Workers clearly demonstrated awareness of, and willingness to, comply with identified safety controls.

C.2.4 Construction

Construction work is performed by LLNL craft employees, Johnson Controls (which provides supplemental labor to LLNL), GSE Construction Company (a construction subcontractor with a continuing presence at LLNL), and other independent contractors. Work control processes vary depending upon the organization performing the work. LLNL craft employees use the LLNL work control process for construction. Johnson Controls employees are integrated into the LLNL workforce and use the LLNL work control processes; for purposes of this report, Johnson Controls employees are not discussed separately but are included under the discussion of LLNL. GSE has voluntarily adopted a similar work control process for its construction activities. Other independent contractors use company-specific processes. The OA team inspected work performed by each of these organizations.

Core Function #1: Define the Scope of Work

LLNL and GSE. LLNL construction workers are required by Plant Engineering procedures to complete and use pre-task hazards analysis worksheets to identify tasks, hazards, and controls for work activities. For most work, tasks to be performed are described daily on pre-task hazards analysis worksheets. Supervisors do not normally participate in the development of pre-task hazards analysis worksheets and do not normally sign them unless they are participating in the work at the job site. GSE workers are expected to define and document tasks, hazards, and controls on safe plan of action forms. The safe plan of action form is essentially the same as a pre-task hazards analysis worksheet except that it includes a space for a supervisor's signature. However, safe plan of action forms were not always signed by supervisors, and GSE had not established procedural requirements for developing or using these forms. The pre-task hazards analysis worksheets and safe plan of action forms were consistently used by LLNL and GSE construction workers and, in general, contained adequate descriptions of tasks to be performed.

The pre-task hazards analysis worksheet and safe plan of action form are important mechanisms for defining and documenting task-level activities associated with construction projects performed by LLNL and GSE employees. These mechanisms ensure worker involvement in work planning. However, because the tasks are not systematically defined until the day that work is to be performed, there is limited time for involvement of supervisors and support organizations, such as Hazard Control and Engineering, in analyzing hazards and establishing controls.

Other Independent Subcontractors. LLNL has broadly defined the scope of work to be performed in construction subcontracts and has included requirements for subcontractors to implement ISM systems consistent with DOE's safety management policy, as defined in DOE Policy 450.4. Pursuant to this policy, a broad scope of work, such as that defined in construction subcontracts, should be translated into tasks that are defined in sufficient detail to support identification of hazards and controls associated with each task. Neither LLNL nor its construction subcontractors has established formal processes for defining tasks associated with subcontracted construction projects, and tasks associated with these projects are not defined in sufficient detail to support identification of task-specific hazards and controls. For example, the scope of work to be performed by an independent construction company for the construction of Buildings 242 and 264 is defined in drawings and specifications, but tasks associated with this work, such as applying asphalt roofing, sanding drywall, spraying textured wall coatings, and installing suspended ceilings, are not specifically defined.

Finding #6. LLNL has not ensured that all independent construction subcontractors fully implement safety management systems consistent with DOE Policy 450.4, *Safety Management System Policy*, and existing processes failed to define work in sufficient detail to support identification of task-specific hazards and controls.

Summary. Construction work performed by LLNL and GSE construction workers is adequately defined but process enhancements are needed to ensure appropriate involvement by supervisors and support personnel. For work performed by independent subcontractors (other than GSE), processes for defining tasks associated with subcontracted construction projects are not established, and tasks were not adequately defined.

Core Function #2: Analyze the Hazards

LLNL and GSE. The hazard identification process for construction work performed by LLNL and GSE relies heavily upon workers for identification of hazards associated with planned tasks. LLNL and GSE workers are expected to identify anticipated hazards and list them daily on pre-task hazards analysis worksheets and safe plans of action. Workers are expected to identify hazards associated with planned tasks by reviewing IWSs, bridging documents, MSDSs, and hazards assessment and control (HAC) forms, and by inspecting the work site. Expectations for performing these reviews, and for preparing pre-task hazards analysis worksheets and safe plans of action, have not been clearly conveyed through training or procedures. Specifically, training has not been provided on the hazard identification process, there is no procedure applicable to GSE for preparation of safe plans of action, and the pre-task hazards analysis procedure does not describe expectations for review of IWSs, bridging documents, or MSDSs and does not adequately address the expected content of pre-task hazards analysis worksheets. For example, the LLNL pre-task hazards analysis procedure does not specify whether all of the applicable hazards listed on IWSs, bridging documents, hazards analysis and control forms, and MSDSs should be recorded on the pre-task hazards analysis, or just those that the worker believes to be particularly important. Performance in this area was not consistent; most workers recorded only those hazards that they believed warranted their focused attention.

Workers use IWSs as an important source of information for identifying anticipated hazards. Job-specific IWSs describe activities to be performed and hazards that are expected for each activity, and blanket or trade/service IWSs provide a comprehensive list of hazards that could occur during a broad scope of construction activities, such as general electrical duties, exterior construction of buildings, and general labor. Because they apply to a broad scope of work, blanket or trade/service IWSs list hazards that may or may not be present, and they do not typically link these hazards to specific tasks to be performed. While use of blanket IWSs is necessary and appropriate for efficient performance of repetitive construction activities, some of these IWSs are so broad that they are of limited value in identifying task-specific hazards to be encountered.

Supervisors are expected to review and sign safe plan of action forms, but the absence of signatures on several forms indicates that the review does not always occur. The procedure for completing pre-task hazards analysis forms does not require supervisors to sign, and there is no designated space on the form for a supervisor's signature. ES&H personnel are involved in the development of IWSs and they respond to requests for assistance from workers and their supervisors during job planning and execution, but they do not normally review safe plan of action forms or pre-task hazards analysis worksheets. Although most hazards are evident to workers and were appropriately addressed on safe plan of action forms and pre-task hazards analysis worksheets, some hazards, such as exposure hazards, are less evident and require involvement of safety specialists to ensure proper identification (see Finding #1).

Other Subcontractors. Appropriate mechanisms have been established for informing construction subcontractors of site-specific hazards associated with the area or environment in which the work will be performed. The procured work service sheets provide an adequate mechanism for informing construction subcontractors of hazards associated with construction sites or locations at which they will be working. The procured work service sheets and referenced documents for modification of Building 321 adequately addressed site-specific hazards. IWS bridging documents adequately inform LLNL and GSE workers of hazards and controls associated with the facilities in which they will be working. Bridging documents, which are used for work performed by LLNL and GSE, are normally used as a supplement to a blanket IWS to identify hazards and controls associated with the job location. For example, a bridging document was used effectively by GSE to identify location-specific hazards and controls associated with the conversion of an industrial facility, Building 324, to a general office facility.

LLNL has not ensured that construction subcontractors develop and implement processes for identification and analysis of hazards associated with construction tasks to be performed. As previously discussed, tasks associated with subcontracted construction projects are not formally defined; thus, it is not possible to systematically identify task-specific hazards. Hazards associated with construction projects are broadly described in task identification process lists, site-specific safety plans, and procured work service sheets. Task identification process lists, which are submitted by subcontractors to "highlight major concerns (i.e., hazards) common to most onsite service activities," are used by LLNL to ensure that subcontractors' site-specific safety plans conform to LLNL ES&H requirements. The lists do not identify some hazards and do not associate hazards associated with specific tasks to be performed. The procured work service sheets, which are prepared by LLNL and incorporated into each construction subcontract, include some foreseeable hazards associated with construction activities. However, because the sheets are prepared early in planning, before specific tasks are identified, and are prepared without worker involvement, hazards associated with specific tasks are not typically included. Task identification process lists, site-specific safety plans, and procured work service sheets are not normally used by construction workers and do not individually or collectively describe hazards associated with specific tasks to be performed by workers.

LLNL has recognized the need for improvement in this area, and has recently added a requirement for pre-task hazards analyses to standard Division 1 Specifications for construction subcontractors. This requirement had not been entered into contracts for work reviewed during this inspection. The pre-task hazards analysis, if properly implemented, would result in the identification of hazards associated with each task, but effective implementation of this requirement will require significant guidance, direction, and monitoring by LLNL.

For the construction projects reviewed during this inspection, some hazards were not adequately analyzed or identified to workers. For example, hazards associated with applying hot asphalt to the roof of Building 242 by a sub-tier construction subcontractor were not adequately analyzed. The procured work service sheets for construction of Building 242 does not address hazards associated with roofing, and the construction subcontractor's safety plan does not discuss roofing. The safety plan describes programs for fall protection and respiratory protection but does not link these programs to roof work, does not indicate that hazardous asphalt fumes are expected during roofing, and does not cite applicable exposure limits for these fumes. LLNL is required by DOE Order 440.1A, Attachment 2, Section 9.b, which is included in LLNL Work Smart Standards, to ensure that worker exposures to chemical hazards are assessed through appropriate workplace monitoring and to record the results of these assessments. The requirement was not met during application of hot asphalt to the roof of Building 242 by a sub-tier subcontractor; assessment of the exposure of roofers to asphalt fumes was not monitored and was not adequate to determine the need for respiratory protection. The construction subcontractor did not have industrial hygiene expertise, and LLNL did not provide industrial hygiene support. The MSDS for application of the asphalt states that respirators should be worn if ventilation is not adequate to control exposure to asphalt fumes below the permissible exposure limit or threshold limiting value. The roofing contractor assumed ventilation was adequate and did not require the use of respirators, but no monitoring was performed to support this assumption and no assessment results were recorded. Data published by the National Institute for Occupational Safety and Health indicates that the threshold limiting value for asphalt fumes may be exceeded during this type of roofing work (see Finding #1).

Summary. LLNL has established appropriate mechanisms for identifying hazards associated with construction work performed by LLNL and GSE employees, but training and procedures need to be strengthened to assure effective use of these mechanisms. Appropriate mechanisms have been established for informing construction subcontractors of site-specific hazards, but LLNL has not assured that construction subcontractors develop and implement processes for identification and analysis of hazards associated with construction tasks to be performed.

Core Function #3: Identify and Implement Controls

LLNL and GSE. LLNL has established appropriate mechanisms for ensuring that safety is systematically integrated into the planning and execution of construction work performed by LLNL and GSE. These mechanisms include permits, IWSs, bridging documents, HAC forms, safe plans of action, and pre-task hazards analysis worksheets. These mechanisms rely heavily upon workers for selecting applicable controls. Training, procedures, and the involvement of supervisors and ES&H personnel do not fully support workers in this regard.

Permits are used effectively by LLNL as a means of ensuring appropriate control of several specific hazards, such as those associated with asbestos, lead, hot work, and excavations. Applicable permits are listed on IWSs for each construction project inspected and are used when required. For example, LLNL permits for soil excavation and for concrete floor, wall, and ceiling penetrations were appropriately used on construction projects. LLNL procedures for identifying utility locations were followed and permit forms were properly completed and posted at job sites. GSE uses LLNL permits, although the LLNL/GSE contract does not mandate their use.

IWSs identify the controls that are applicable for each construction project. Job-specific IWSs identify work activities to be performed and specify the controls required for each activity. For example, the job-specific IWS for removing the roof from Building 490 specified controls required for each planned activity. Blanket or service/trade IWSs, which typically cover a broad scope of work, link hazards that may be encountered to controls that may be applied. However, controls specified on these IWSs are not tailored or linked to specific tasks and often do not clearly specify which controls must be applied. As examples:

- Training requirements are not adequately addressed on blanket or service/trade IWSs. OSHA training requirements are not cited, course numbers are not always given for in-house training, and the specific tasks for which the training is mandatory are not specified.

- PPE is often identified as a control without specifying which PPE is required.

- Controls specified by MSDSs for exposures to hazardous materials are not typically stated on blanket or service/trade IWSs. Instead, these worksheets contain a general requirement to comply with applicable MSDS requirements. Some MSDSs require evaluation of job-specific conditions to determine the applicable controls. Most applicable MSDSs were available at subcontractors' construction sites and, with the exception of controls for asphalt fumes at Building 242, appropriate controls were implemented.

- Procedures are referenced in a general manner on some worksheets without identifying the specific procedures that must be followed.

Bridging documents are sometimes used to supplement the general control requirements in IWSs with more job-specific requirements. Although bridging documents are intended primarily as a means of informing workers of controls for hazards endemic to the area or facility where the work is to be done, these documents are sometimes used to specify controls associated with work activities, such as requirements for permits and HAC forms. This information is needed as a supplement to the more general requirements in IWSs, but is not required by procedure and is not always provided.

HAC forms are used by ES&H teams to inform LLNL and GSE construction organizations of unique hazards associated with planned work. They are typically used to identify respiratory hazards and controls. These forms are generated when ES&H teams identify the need for these controls based upon their review of IWSs and bridging documents and upon discussions with workers and supervisors. The HAC forms provide specific controls that are needed to supplement more general requirements in IWSs. For example, a sitewide HAC form for control of silica exposures specifies appropriate engineering controls and PPE for controlling exposures to airborne silica during cutting and drilling concrete based upon a comprehensive hazards analysis. However, the HAC form process is not consistently implemented. Individuals preparing, reviewing, and approving the forms are not always clearly identified on the forms, and the content and format of the forms varies significantly. Some forms include a signature sheet for workers to acknowledge that they received a pre-job briefing and some do not. The signature sheets, when provided, are not always signed by workers. The HAC forms for PPE on one project contained no requirements other than stating "minimum PPE guidelines," and some of these minimum guidelines, (i.e., use of P100 respirators and Tyvek clothing) were not implemented. Electronic mail has been used to provide clarification and additional controls for HAC forms (see Findings #1 and #4).

Pre-task hazards analyses worksheets and safe plans of action forms link controls to tasks. These processes rely heavily on the worker for selection of controls, especially when a blanket IWS is used. For LLNL and GSE workers, these selections are documented on pre-task hazards analysis worksheets and safe plan of action forms respectively. As previously discussed, training and procedures do not adequately convey expectations for development of safe plan of action forms or pre-task hazards analysis worksheets, and involvement of supervisors and ES&H personnel is limited. This process is particularly problematic for establishing controls because documents available to workers do not always clearly specify which controls are required (see Finding #1).

Subcontractors other than GSE. Construction subcontracts require subcontractors to comply with OSHA and State of California safety requirements and to establish a safety management program consistent with the DOE safety management policy (DOE Policy 450.4). Subcontractors are required to obtain LLNL approval of their safety plans before they start work and are expected to follow these plans during construction. In general, LLNL safety processes and procedures have not been applied to construction subcontractors (other than GSE). Subcontracts require compliance with LLNL permits for excavations and penetrations and for confined spaces but do not require compliance with LLNL processes for establishing controls, such as procedures for use of IWSs, bridging documents, or pre-task hazards analysis worksheets. Construction subcontractors had not established programs for safety management that included systematic identification and documentation of controls to be applied for planned tasks. They have relied primarily upon the knowledge of their employees and subcontractors for identifying applicable controls from safety plans, MSDSs, and regulatory requirements prior to performing assigned tasks.

Most safety requirements applicable to LLNL construction activities have been effectively managed. The requirements are maintained in the Work Smart Standards and are flowed down to the construction workforce through manuals, procedures, and subcontracts. For example, the ISM requirement for Clause I-066 of the DOE/University of California (UC) contract, and the construction safety requirements in DOE Order 440.1A, Attachment 2, Section 14, were incorporated in subcontracts for each project reviewed during this inspection.

However, some safety requirements that are included in the DOE/UC contract as Work Smart Standards have not been flowed down to GSE or other construction subcontractors. Clause I-066 in the DOE/UC contract requires compliance with LLNL Work Smart Standards regardless of who performs the work and states that the contractor is responsible for flowing down the requirements of this clause to subcontracts at any tier to the extent necessary to ensure compliance. The following requirements were in LLNL Work Smart Standards but were not included in *LLNL Facilities Specifications* or construction subcontracts:

- DOE Order 440.1A, Attachment 2, Section 5: "Encourage employee involvement in the identification and control of hazards in the workplace." This requirement was not imposed and is not being met by the construction subcontractor for Buildings 242 and 264. LLNL identified the need for increased worker involvement and added a requirement for use of pre-task hazards analysis work sheets to Division 1 specifications in March 2004, for inclusion in future construction subcontracts.

- DOE Order 440.1A, Attachment 2, Section 9.b: "Assess worker exposure to chemical, physical, biological, and ergonomic hazards through appropriate workplace monitoring. Monitoring results shall be recorded." This requirement was not imposed and is not being met by the construction subcontractor for Buildings 242 and 264, for assessing exposures to asphalt fumes.

- American Conference of Governmental Industrial Hygienists threshold limit values. These requirements were imposed for demolition, working with lead, and for certain heating, ventilation, and air conditioning (HVAC) work but were not imposed for other activities. This requirement was not imposed and was not included in subcontractors' safety plans.

- DOE Order 440.1A, Attachment 2, Section 8: "Inform workers of their rights by appropriate means." This requirement was not imposed and is not being met by the subcontractor for Buildings 242 and 264.

Finding #7. LLNL has not ensured flowdown of some ES&H requirements to construction subcontractors to the extent necessary to ensure compliance as required by Clause I-066 of the DOE/UC contract.

Summary. LLNL has established appropriate mechanisms for ensuring that safety is integrated into the planning and execution of construction work performed by LLNL and GSE but has not provided the training, procedures, or supervisory oversight necessary to ensure the fully effective implementation of these mechanisms. LLNL construction subcontractors have not established safety management programs that require systematic identification and documentation of controls to be applied for planned tasks.

Core Function #4: Perform Work Within Controls

Most construction work practices indicated an awareness of hazards and a desire to comply with established controls. All LLNL and GSE construction workers interviewed during this inspection were working to a current pre-task hazards analysis or safe plan of action. PPE requirements were consistently met; tools, fall protection equipment, and extension cords were in good condition; and housekeeping was good. Appropriate fall protection was being used and temporary power was protected with ground fault circuit interrupters as required.

However, a few unsafe practices were observed by the OA team. A bottle of compressed gas was stored in a horizontal position as opposed to vertical as required by OSHA; a worker climbed a ladder with a lighted torch; sparks from a metal saw were falling into a waste can that contained combustible materials; and no guard rail or other fall protection was provided for an opening in the roof of Building 242. Each deficiency was promptly corrected.

Work authorization processes ensure adequate consideration of safety before the start of construction. For construction performed by subcontractors other than GSE, the LLNL procurement process assures that appropriate safety controls are established and that a designated responsible LLNL individual has accepted responsibility for safety before formal authorization to proceed is granted. For construction performed by LLNL or GSE employees, work is not authorized to proceed until responsible organizations agree that it is safe to do so. This agreement is documented on a bridging document, which is signed by a FPOC and the construction organization performing the work. These processes were adequately implemented for projects reviewed during this inspection.

Summary. With a few exceptions, construction work was performed with a high regard for safety. Work authorization processes were effectively implemented and ensure adequate consideration of safety before the start of construction.

C.2.5 Waste Management

OA's inspection of the first four core functions of ISM for waste management activities at LLNL focused on the adequacy of waste management activities and operations, such as waste generation, collection, and storage. OA also evaluated progress and corrections made for select items identified during the previous OA inspection of LLNL in 2002. In performing this inspection, the OA team evaluated the effectiveness and implementation of policy and procedures, examined selected facilities and operations, and interviewed environmental, operations, and facility personnel. Concurrent with the review of waste management, OA evaluated selected aspects of LLNL's progress on implementing an environmental management system.

Core Function #1: Define the Scope of Work

Waste management funding and program direction currently is under the direction of the Office of Environmental Management. In FY 2006, funding and program direction responsibilities for waste management (including legacy wastes and currently generated wastes) will transition to the National Nuclear Security Administration (NNSA).

At the facility level, the safety plan for waste management operations effectively defines the work to be performed so that the hazards and controls can be addressed. The FSP defines the work to occur within the Radioactive and Hazardous Waste Management storage facilities and treatment facilities, including the facility operations and personnel responsibilities and authorities. The plan draws upon ISM principles and policy from the ES&H Manual and defines use of the ES&H team that supports operations and the responsibilities for this support. The plan effectively defines the safety envelope for the building safety limits and controls. For example, the plan requires using approved transuranic waste containers, conducting weekly inspections, and monitoring large transuranic waste containers for bulging quarterly. For fire protection, the plan limits the amount of combustible material in storage areas and requires use of metal pallets. The plan also includes appropriate provisions for forklift operator training and adherence to posted traffic controls.

Environmental Management System. LLNL has ongoing efforts to revise its environmental management program, which includes elements of an environmental management system, to conform to ISO 14001. LLNL, in preparation for reaching conformance with ISO 14001, has issued an environmental policy. This policy is a key element of ISO 14001 and defines senior management's commitment to the environmental management system and compliance with environmental requirements. LLNL has also had a subject matter expert from Los Alamos National Laboratory conduct a gap analysis, which included a comparison of LLNL's environmental programs with both ISO 14001 requirements and the requirements presented in DOE Order 450.1 *Environmental Protection Program*. The gap analysis recommended improvements in the area of documenting and communicating objectives and targets, which is a foundation for ISO 14001. LLNL is taking actions to address the gap analysis recommendation.

LLNL plans to meet the requirements of Executive Order 13148, *Greening the Government through Leadership in Environmental Management,* for an environmental management system in December 2005. However, progress toward reaching this requirement has been lagging, based on the site-level matrix schedule established by the Office of Federal Environmental Executive. DOE Order 450.1 requires DOE field elements to report on the status of the environmental management system by December 31, 2005. Because of LLNL's limited progress in achieving milestones, there may not be sufficient time for the Livermore Site Office (LSO) to evaluate the LLNL implementation and self-certification of an environmental management system prior to the December 31, 2005 reporting deadline. As result, LSO may be forced to report the status of a system it has not had sufficient time to evaluate.

Summary. LLNL's safety plan for waste management operations effectively defines the work to be performed so that the hazards and controls can be addressed. LLNL has a plan to implement its environmental management system by the Executive Order 13148 deadline, but limited progress to date may not allow sufficient time for LSO to evaluate its effectiveness before it must report on the status.

Core Function #2: Analyze the Hazards

LLNL has mature processes for analyzing hazards associated with waste management activities. An extensive review was performed before operations began in the new waste management treatment and storage facilities to ensure the analysis of hazards as defined in requirements for safety and environmental compliance from external regulators, DOE orders, and the ES&H Manual. In most cases, waste management hazards were appropriately analyzed. In addition, LLNL Waste Generator Services personnel are deployed to line organizations and have identified several opportunities to reduce or prevent pollution-related hazards. For example, LLNL implemented a program of using a vendor to treat plastic containers so that they can be used for collecting corrosive liquids, thus reducing the hazards associated with glass containers. LLNL also implemented a waste segregation process and trained waste generators to not mix radioactive waste with non-regulated waste so that the volume of mixed waste is minimized.

However, a few concerns were identified involving hazards analysis. IWSs are used at the Decontamination and Waste Treatment Facility (Building 695) for treating wastes and developing new waste treatment processes, but are non-specific with respect to hazards and associated controls. The IWSs direct the worker to other documents, such as processing plans, FSPs, the ES&H Manual, and HAC forms. In addition, the IWS for Depleted Uranium Deactivation did not address hazards associated with use of a crane for unloading uranium chips (see Finding #1).

Summary. In most cases, hazards associated with waste management were appropriately analyzed, and LLNL has implemented a number of pollution prevention mechanisms. However, a few concerns were identified involving the specificity of IWS hazards analyses.

Core Function #3: Identify and Implement Controls

To provide direct support for management of waste functions and to ensure that controls are implemented for waste management activities in line organizations, LLNL requires lines organizations to fund deployed Waste Generator Services personnel. This is an enhancement from the 2002 OA inspection, when the service was optional.

Waste Generator Services personnel provide direct support to waste generators and have implemented several controls. For example, a system for central management of containers and labels was implemented to control and minimize generation of waste.

Technical support for ensuring that safety controls for waste management operations are developed and implemented is performed by deployed ES&H team members. ES&H team members also participate in self-assessments of waste operations. The deployment of ES&H expertise ensures that ES&H has been integrated into waste operations and promotes development and implementation of effective controls.

For the most part, the controls associated with waste management operations are mature and appropriate. These controls have been developed to meet strict regulatory requirements and are frequently reviewed by external regulators.

In some cases, facility management implemented effective facility-specific controls. For example, the plating shop has instituted a comprehensive chemical management system for ensuring that only the necessary chemicals are held in long-term storage and that those chemicals can be easily located for reuse. Management of chemicals was a concern during the 2002 OA inspection.

Although the waste management controls are generally adequate, OA identified a few instances where the controls are not fully documented in IWSs. For example, the IWS for Routine Operations Covered in Area 612 FSP has identified pyrophoric-, thermally-, shock-, or friction-sensitive materials and perchlorates as hazards. However, the only controls listed are for PPE, including gloves, safety glasses and shoes, and respiratory protection. Other appropriate controls are not specifically discussed, such as storing these higher-risk items in special locations with blast protection, ensuring that pyrophorics are kept under liquid, and providing additional labeling to highlight the need to handle these shock-sensitive containers with care. In addition, the IWS for Depleted Uranium Deactivation at the waste treatment facility did not identify important process controls, such as temperature control for the deactivation reactor vessel, a system to monitor the pH of the reaction slurry, and controls on air exposure of uranium chips prior to acid treatment. In practice, these controls were in place; however, their omission from the IWSs increases the likelihood that the controls could inadvertently not be performed (see Finding #2).

Currently, the waste management organization does not have an automated method to ensure compliance with limits for storage of hazardous waste in the central less-than-90-day storage area. Therefore, personnel at the waste operations facilities use a visual inspection of waste containers to identify containers that must be shipped. The waste management organization plans to implement an electronic tickler system to flag containers that need to be processed before exceeding the Resource Conservation and Recovery Act compliance 90-day limit, but the system has not yet been implemented.

Summary. In most cases, hazards associated with waste management were appropriately controlled. However, IWSs do not always comprehensively define the needed controls.

Core Function #4: Perform Work Within Controls

Overall, the old and new central waste management facilities were being effectively operated and were in compliance with Resource Conservation and Recovery Act and DOE Order 435.1, *Radioactive Waste Management*, requirements. These requirements included labeling, maintaining the containers in acceptable condition, signs and postings, access controls, and safety equipment, including eye wash stations.

The new facilities at the Decontamination and Waste Treatment Facility allow storage of containers inside large bays. The old facility in the 612 area has some containers in outside storage, but these containers are scheduled for disposal within this fiscal year. The containers are in an acceptable condition for unprotected storage until their planned disposition.

Waste management operations within facilities were being effectively performed by the generator organizations. In satellite accumulation areas, the hazardous waste containers were being posted with hazardous labels that included the start dates (California environmental regulations limits storage of containers in satellite accumulation areas to one year); containers holding liquids were placed within secondary containment; containers were kept closed; and the container owners were clearly identified. The generator organizations had received the required waste management training. Deployed Waste Generator Services personnel were also effectively operating the less-than-90-day waste storage area. Signs were posted, waste structures were locked, weekly inspections were being conducted, and a contingency plan for the area was posted. A 90-day spread sheet was being used to ensure that the regulatory limit was not exceeded.

Although overall waste management operations were effectively performed, a few items needing additional attention were identified. These are discussed in the following paragraphs and contribute to Findings #2 and #3.

The engineering support building (Building 231) has an area used for storing material for the Plant Engineering Department's plastics shop. This area had been cleaned recently but still had a large number of old containers stored in a manner that would not allow easy recovery. The user of the area knew where everything was located; the containers are labeled and the MSDSs are available. However, this reliance on personal knowledge about the container locations increases the likelihood that the containers could become legacy waste if the knowledgeable person becomes unavailable.

A container marked as containing pump oil and mercury in a radioactive area in Building 231 was not being effectively managed as a container of potentially mixed waste. The container was being stored inside a secondary container but did not have any marking or labels except the words "pump oil" and "mercury." LLNL determined that the contents were from the draining of laboratory equipment and that waste management personnel had been contacted after the waste was generated to perform a characterization of the constituents so that the container could be transferred to waste management for disposal. These circumstances indicate that Waste Generator Services personnel had not been adequately involved during the planning for this clean-out project so that the constituents could be identified and appropriate controls could be applied.

Equipment relocated to the new waste management facility does not meet safety requirements. A drill press, a grinder, and a belt sander were moved from the old waste management facility and reinstalled at the new facility. The IWS for Building 695 Facility Operations indicates that there are hazards from using machine tools and power-actuated tools and requires controls that include having all the parts present. However, the protective glass was missing from one grinder shield.

Information in the waste tracking system did not match information on the container in one case. A container label in the less-than-90-day storage area at the old waste management facility showed an accumulation start date of July 30, 2004. However, the waste tracking system shows the accumulation date as September 27, 2004, for the container.

Summary. In most cases, waste management operations are performed in accordance with applicable controls. However, in a few instances, facility conditions indicate a need for more rigor in implementing controls.

C.2.6 Environmental Restoration Activities

LLNL's Environmental Restoration Division (ERD) investigates and cleans up soil and ground water contaminated by past activities of LLNL and predecessor organizations at Livermore's main site and Site 300. ERD operations include the evaluation, selection, and implementation of environmental restoration technologies, including conducting restoration of soil and ground water to comply with state and Federal regulations and to protect public health and the environment. The division designs, installs, and manages a broad array of investigation and remediation technologies and approaches in accordance with DOE, Environmental Protection Agency (EPA), State Regional Water Quality Control Board, and California Department of Toxic Substances Control requirements. The OA review focused on safety management aspects of ERD operations and support activities and subcontractor activities managed by LLNL within ERD facilities.

Core Function #1: Define the Scope of Work

Scopes of work for ERD operations and related fieldwork activities are generally well defined in standard operating procedures (SOPs), OSPs, IWSs, and/or groundwater sampling/monitoring planning documents. Additionally, environmental restoration, compliance monitoring, and contingency planning documents for Livermore's main site and Site 300 bound the scope of authorized activities that can be conducted in accordance with the respective Record of Decision (ROD) or Interim ROD for remedial action at these two locations. Due to the type of remediation activities currently conducted, an FSP has not been required.

For the most part, OSPs and procedures provide adequate work scope definition such that hazards and controls can be identified. However, individual scopes of work for some ancillary activities conducted by ERD at fixed facilities or field locations are not documented in sufficient detail such that activity-level hazards and controls can be identified. For example, the IWS for Treatability Testing and Related

Activities has a broad scope and covers a wide range of activities for field ERD activities and operation of ERD facilities; however, this IWS lacks specifics on individual authorized work scopes (see Finding #1).

Summary. Work control processes are established for ERD operations and most working documents sufficiently describe the planned activity, scope, schedule, and requirements. However, some work scopes for ancillary activities are not described in sufficient detail to effectively analyze and control hazards.

Core Function #2: Analyze the Hazards

The primary mechanisms used to document hazards associated with ERD work activities are OSPs and IWSs. The OSPs are used to supplement the ES&H Manual and provide a suitable mechanism and protocol for identifying and analyzing most activity-level hazards at ERD facilities and field locations. Recent integration of OSP content with the IWS process provides an appropriate framework for identifying hazards applicable to a specific work scope. Additionally, the IWS serves as a reference to such resources as the ES&H Manual, ERD Operations and Maintenance Manual subject areas, and ES&H team points of contact for further information as well as to possible controls that may be needed for those hazards explicitly identified.

While adequate systems for scope definition and hazards analysis were in place, ineffective implementation of these systems has, at times, resulted in incomplete or ineffective hazards analysis. As a result not all hazards associated with ERD work activities have been sufficiently identified or analyzed using the OSP and IWS hazards analysis and control processes. Specifically, work plans and procedures did not always include all applicable hazards in the IWS and OSPs. For example, electrical hazards are not identified as a potential hazard for well logging activities, and hazards associated with machine shop activities were omitted. Additionally, changes to processes or equipment that result in the potential for new hazards have not been managed in accordance with OSP requirements. As a result, there has been limited monitoring of some known hazards and insufficient analysis of potential impacts to workers and the need for additional controls. For example, only one industrial hygiene assessment/survey of noise levels for well drilling operations has been conducted in the past four years (in 2000), even though equipment has been added and operations have changed. Monitoring conducted by LLNL (in response to an OA team request) has indicated the potential for two individuals to receive time-weighted-average exposures greater than the 85 dBA level at which individuals must participate in a hearing conservation program with required audiometric testing. Additional hazards analyses deficiencies included: lack of a documented burn permit assessment of fire potential at a fixed welding location established in Building 438; lack of a formal characterization to confirm the adequacy of ventilation in the machine shop area; lack of a documented technical basis for vapor monitoring and associated trigger levels available or related to the drilling geologist providing ES&H assessment and oversight during drilling operations; lack of a documented assessment of exposure potential to workers from fumes from diesel and/or gasoline-powered equipment; lack of an IWS that addresses research conducted by visiting college students related to the storage, retrieval, and use of soil core samples for potential mold generation; and lack of clear documentation of other hazardous constituents in safety documentation (see Findings #2 and #3).

Summary. Although a formal mechanism exists for identifying and analyzing hazards associated with ERD work activities, in some cases, insufficient rigor is applied to these processes, resulting in hazards that have not been properly identified or analyzed. The hazards of some activities have not been evaluated and documented such that appropriate controls can be ensured. In other cases, requirements were not implemented that would have ensured identification of potential hazards.

Core Function #3: Identify and Implement Controls

ERD facilities and operations make use of engineered controls where applicable; these serve as a primary mechanism to control many activity-level hazards. Engineered controls include such items as ventilation systems, enclosures, drill rig design, and fabrication of treatment facilities, and the design of the controls takes into account potential hazards specific to the work. Additionally, ERD has established OSPs and IWSs to identify hazards and to serve as administrative controls of operational work within ERD facilities and field activities. The OSP and the IWS, to a lesser extent, provide a central source of documentation where work rationale, responsibilities, scope, operations, and related hazards/controls are presented. Additionally, these documents provide a reference to training, maintenance, inspection, quality assurance, emergency response, and change control requirements for both operations and equipment. In addition to engineering and administrative controls, ES&H subject matter experts have been effectively integrated into the ERD work planning process. The ES&H team concept provides a cadre of safety and health resources to the ERD responsible individual in the development of OSPs and IWSs for new activities. Additionally, ERD has assigned Site Safety Officers to oversee both the Livermore main site and Site 300 ERD operations.

While the combination of engineering and administrative controls can result in effective controls, deficiencies in implementation of work planning and ES&H requirements in ERD operations and facilities have resulted in inadequate or poorly defined controls during some work evolutions, which result in the potential for adverse safety consequences. These deficiencies are discussed in the following paragraphs.

IWSs do not always contain enough clarity, specificity, and detail with regard to expected hazardous conditions and accompanying required controls. Some potentially hazardous activities included under a broadly scoped IWS often are vague or lack sufficient detail to clearly determine the hazards at the activity level. For example, IWS 11534 Revision 3, developed by Livermore Site ERD with concurrence by ES&H Team 4, primarily addresses field ERD activities and covers activities ranging from design, fabrication, and start-up testing of treatment systems to operation of EPD facilities. Although the IWS makes a passing reference to the Building 438 weld shop, the hazards and controls associated with weld shop operations (e.g., machine shields, hearing and eye protection, types of training required, mechanical motion hazard controls, and equipment inspection prior to use) are not considered (see Finding #1).

ERD SOPs have not been developed in a manner that incorporates specific activity-level controls in the work instructions. While some procedures include reference to some of the expected hazards, controls typically found in the OSP or IWS are not included at the work step of a given procedure. The LLNL ES&H Manual (Document 3.4, Work Documents) recommends inclusion of safety considerations, but provides little guidance on the actual content and method of inclusion (e.g., by reference or as a hold point). Reviews of ERD SOPs indicate that recently developed (2003-2004) SOPs or revised SOPs appear to have omitted references to safety considerations. This situation is further complicated by the EPA quality review cycle for approval of procedures (see Finding #2).

Some controls required in a given OSP or IWS have not been implemented as specified, and some specified controls that are implemented have no documented technical basis. For example, OSP requirements for controlling changes to operations or equipment may specify an additional hazards assessment; however, an assessment of noise levels was not conducted for drilling operations as required (see Core Function #2) and, although hearing protection was used, workers who were considered as enrolled in a subcontractor hearing conservation program did not undergo audiometric evaluation. Additionally, some hazard controls for well drilling operations were not implemented as required by the OSP. For example, the *Livermore On-Site Ground Water Investigation Activities OSP* requires the drilling geologist to monitor breathing zone concentrations and drill cuttings with an Organic Vapor Monitor and/or Organic Vapor Analyzer for potential impact on worker health and safety; however, the actual measurements conducted were limited to drill cuttings and a minimal general area measurement at waist height, which is not reflective of the actual work area of concern, and workers' elevation on the drill platform, which is not representative of the workers' breathing zone. At Building 438, OA identified a fixed welding location that did not have a current documented approval (i.e., burn permit) or an assessment of the adequacy of controls. Welding activities in Building 438 were conducted without a hot work permit from the LLNL fire department, based on an assumption that the activity was being conducted in an approved location; however, no actual approval could be demonstrated. ES&H Manual Document 22.5, Fire, Section 4.6, *Permits for Welding, Burning, or Other Hazardous Operations*, stipulates "as part of the LLNL program to control fire hazards, permits are required for welding, soldering, and other hot-work operations with a high fire potential." Approved locations for hot work are areas that have been either designed specifically for that purpose or modified to accommodate such operations safely. At the time of the OA inspection, the fire department had no hot work permit on record. In either case, the issued permit would have been required to be posted, and no posting was available. The lack of a posting should have raised a question previously as to the location's "approved" status, but this shortfall was not identified, even though a recent ES&H Team 4 assessment, which included fire protection, had been conducted. The Livermore ERD Site Safety Officer monitors and assesses the facility, and monthly fire extinguisher inspections in the facility are required (see Findings #1 and #2).

Some required safety equipment specified was not enforced (e.g., a safety fuel can equipped with flash suppressor was required in the well drilling OSP, and an eye wash station listed in the subcontractor's safety equipment appendix required safety equipment that was not available at the drill site). For both the safety fuel can and eye wash station, site ES&H team personnel indicated that these items are not required based on current ES&H Manual requirements; however, the documented controls have not been updated. Some activities have been allowed to proceed with no IWS developed to address hazards and controls; for example, visiting students or researchers who come into contact with drilling core samples and potentially hazardous constituents have no documented IWS. No documented technical basis for vapor monitoring and associated trigger levels for ES&H assessment was available or related to the drilling geologist providing oversight during drilling operations, though a subsequent ES&H team assessment of the trigger levels indicated that the trigger levels were sufficient (see Findings #3 and #4).

Summary. Formal processes that identify ERD management expectations for identifying and controlling workplace hazards have been developed. However, implementation of these processes, including the development of procedures and certain health and safety requirements contained in OSPs and/or IWSs, have not been completely effective.

Core Function #4: Perform Work Within Controls

ERD facilities make good use of pre-job or plan-of-the-day meetings to define daily work evolutions at both Livermore and Site 300 facilities. Site 300's testing status and conditions are reviewed, and scheduling of ERD activities is discussed and authorized by management prior to initiating work. These mechanisms provide adequate assurance of readiness to perform work within ERD operations and facilities.

With some exceptions, ERD work observed by the OA team was conducted safely and in accordance with the established controls. Workers and line management were knowledgeable of their operations and facilities and had considerable experience within their areas of expertise. The ion exchange resin replacement at Site 300 was an example of a work evolution that followed all required controls, including use of lifting devices and appropriate PPE. Sampling of the ground water level and actual well sampling were performed by procedure and included the appropriate PPE and application of controls for inclement weather. Sampling of off gas stream from an operational vapor extraction system was performed safely and followed all applicable requirements.

In a few cases, work was not performed in strict accordance with established controls. Electrical panels, although posted "keep clear within 36," were obstructed with objects at ERD facilities at both the Livermore main site and Site 300. Workers were observed handling materials in the immediate area and did not heed the postings. In some cases, proper industrial hygiene monitoring practices were not followed. For example, monitoring conducted by a drilling geologist was not representative of the breathing zone as directed by the OSP. Although ERD facilities are routinely inspected by ERD management and ES&H teams, they contained some PPE that was not in good condition and readily available for use (i.e., the face shield at the Building 438 machine shop was in poor condition), and the machine shop had not been evaluated and appropriately included in an IWS. For drilling operations, although the potential for eye contact with drill cuttings from well drilling operations exists, no eye wash station was deemed necessary by the ES&H team. Pre-job briefings observed by the OA team were more targeted on the plan of the day, with only minor discussion of safety concerns, placing heavy reliance on the workers' knowledge of hazards and controls, and little or no reference to SOPs or IWS/OSP documentation during routine conduct of work activities (see Findings #3 and #4).

Summary. Formal conduct of operations within ERD facilities and field activities, including development of SOPs for most activities, documented work plans, and required training, provides adequate assurance of readiness to perform work. However, facility safety measures were not sufficiently rigorous in some cases, and pre-job briefings did not consistently address activity-level hazards and controls for a given day's work. While several work evolutions with well-defined controls were performed in accordance with expectations, some hazard controls were not effectively implemented and maintained.

C.3 CONCLUSIONS

As discussed below, effectiveness in implementing the core functions of ISM varies across the six activities reviewed (NMTP, PAT R&D activities, maintenance activities, construction activities, waste management operations, and environmental restoration activities).

NMTP demonstrated effective implementation of ISM in many areas. The scope of work and schedule for NMTP work was well defined, and work activity hazards were generally identified and analyzed appropriately. NMTP effectively uses a combination of engineering and administrative controls to prevent and mitigate hazards associated with programmatic operations, and most work evolutions reviewed were appropriately authorized and performed safely in accordance with established controls. However, OA identified systematic deficiencies that prevent fully effective ISM within NMTP facilities. Weaknesses in implementation of some controls jeopardize their effectiveness, including the lack of a systematic approach to the conduct of required ALARA reviews, insufficient procedural instruction for performance of some duties, and a lack of rigor in following existing requirements or establishing appropriate technical bases for variations. In some cases, workers failed to follow established safety rules or requirements, and management tolerated non-conservative interpretations of safety rules or requirements without initiating appropriate corrective actions. NMTP has not ensured that activities are performed with the rigor expected in a Category 2 nuclear facility and that supervisors and workers either follow safety requirements as written or stop the work activity until the requirements are corrected.

For the PAT Directorate, the LLNL IWS process, as described in the ES&H Manual, adequately addresses most aspects of research and experimental work. Work scopes for research conducted within the PAT Directorate are adequately defined in IWSs, FSPs, work documents, and facility-level hazards analyses, such as safety assessment documents and hazards analyses reports. The implementation of research work control processes has resulted in the PAT Directorate achieving the lowest injury and illness rates among all the LLNL directorates. However, the OA team also observed a number of opportunities for improvement, particularly with the implementation of the IWS process. Some work activities have not been adequately addressed in IWSs, and a number of hazards and controls were missed. In addition, some safety procedures were not adequately followed, some work documents were not integrated into IWS documents, and some ES&H training requirements were not clearly defined.

A significant amount of work is performed by the Plant Engineering Department on a daily basis at LLNL. Work controls by the NIF work team indicated that conscientious attention to the written instructions and policies adopted by LLNL can result in clear and effective written instructions to workers. These instructions effectively supplement the knowledge and skills of the workforce. Processes at this facility are effectively implemented because the NIF project team sets high expectations and ensures that work in this organization is clearly defined. Very little of the Plant Engineering work at the remainder of the LLNL facilities is subject to the detailed planning expected of an effective ISM system. Instead, the system relies heavily on verbal communication, electronic mail, and other memoranda between craft personnel, FPOCs, ES&H personnel, and customers. Decisions reached during those communications are not always captured within work documents, leaving workers to rely on their individual expertise to be aware of and control hazards. Workers were aware of most of the hazards they could be exposed to, but there were cases where hazards were not adequately identified, controls were not clearly implemented, and laboratory safety policies were not followed.

For construction activities, the work control process for activities performed by LLNL and GSE contains essential elements for integrating safety into planning and work execution. The process includes provisions to define the scope of work to be performed, identify associated hazards and controls, and ensure readiness before authorizing work. However, the process relies heavily on workers for identifying tasks and task-specific hazards and controls, and training, procedures, and the involvement of supervisors and ES&H personnel do not fully support workers in this regard. Worker involvement is appropriate and is an important element of ISM, but some procedures, processes, and training are not adequate to support this level of involvement. In particular, processes do not include sufficient involvement of supervisors or ES&H personnel to ensure identification and control of hazards that may not be evident to workers. The use of blanket IWSs increases efficiency by reducing planning time but does not always describe activities, hazards, and controls with sufficient specificity to support identification of hazards and controls. LLNL has included a requirement for ISM in construction subcontracts but has not ensured that these subcontractors establish the formal processes necessary to systematically integrate safety into work planning and execution. In particular, planning by these subcontractors does not include systematic identification of tasks, hazards, and controls as specified by the DOE safety management system policy.

Most hazards associated with waste management activities are adequately identified, analyzed, and controlled in both the central waste management facilities and at the point of generation within the divisions. These activities are being performed in compliance with external regulations and DOE and LLNL requirements. Several enhancements in waste management operations have been made in the past two years with the transfer of most waste operations to the new waste treatment and storage facility.

However, IWS hazards analysis and controls and labeling were not sufficiently rigorous in a few areas. Limited progress in developing the LLNL environmental management systems may impact meeting the requirements set by Executive Order 13148.

ERD's operation of both field activities and fixed facilities at Livermore's main site and Site 300 demonstrate a strong commitment to safety. However, more disciplined operations and more rigorous implementation of the work planning and control processes are needed to ensure that DOE requirements are effectively implemented. The application of the LLNL IWS process and conversion from OSPs to newer IWSs is an effort to consolidate hazards and controls in a single document; however, this process requires continued attention, particularly at the activity level to ensure that discrete work tasks and potential hazards are identified with their associated controls. Integration of ES&H subject matter experts into the work planning process has been implemented through the formation of ES&H teams assigned to support activities at the division level. The addition of this capability provides a ready resource to management to ensure that appropriate hazard controls are identified and implemented. Implementation of this capability, however, was not always sufficiently rigorous. Work and facilities observed did not always have the hazard controls implemented as intended, and the ES&H Manual requirements were not always explicitly addressed in work planning documents.

Overall, LSO and LLNL have a number of systems that are conceptually sound but are implemented with varying levels of effectiveness across and within the various directorates. Many work activities were performed with a high regard for safety. However, there are systemic deficiencies in implementing the work control processes, ensuring adequate work instructions, adhering to work instructions, and ensuring that process and performance deficiencies are identified and corrected at the activity level. Management attention is needed to ensure that these problems are effectively addressed.

C.4 RATINGS

LLNL ACTIVITY	**CORE FUNCTION RATINGS**			
	Core Function #1 – Define the Scope of Work	**Core Function #2 – Analyze the Hazards**	**Core Function #3 – Identify and Implement Controls**	**Core Function #4 – Perform Work Within Controls**
NMTP	Effective Performance	Effective Performance	Needs Improvement	Needs Improvement
PAT R&D	Effective Performance	Needs Improvement	Needs Improvement	Effective Performance
Maintenance Activities	Needs Improvement	Needs Improvement	Needs Improvement	Effective Performance
Construction Activities	Needs Improvement	Needs Improvement	Needs Improvement	Effective Performance
Waste Management Operations	Effective Performance	Effective Performance	Effective Performance	Effective Performance
Environmental Restoration Activities	Effective Performance	Needs Improvement	Needs Improvement	Effective Performance

C.5 OPPORTUNITIES FOR IMPROVEMENT

This OA inspection identified the following opportunities for improvement. These potential enhancements are not intended to be prescriptive or mandatory. Rather, they are offered to the site to be reviewed and evaluated by the responsible line management, and accepted, rejected, or modified as appropriate, in accordance with site-specific program objectives and priorities.

NNSA/LSO

1. **LSO needs to set clear expectations to hold LLNL accountable for implementing and self-certifying an environmental management system by December 31, 2005, as required by Executive Order 13148.**

LLNL – Institutional

1. **Increase the rigor associated with procedure and requirements compliance. Strengthen management and worker awareness that failure to follow a specified requirement or procedure is cause for stopping a work activity and initiating corrective action.** Specific actions to consider include:

   - Conduct training to reinforce awareness on procedure compliance and the importance of a disciplined safety culture that ensures that requirements and procedures are accurate and are either followed or corrected before proceeding.
   - Use safety meetings and other existing safety communication methods to continue reinforcement of a disciplined safety culture.
   - Increase attention to procedure compliance aspects of work control during future audit and assessment activities and management walkthroughs.
   - Revise preventive maintenance task codes to accurately tailor the list of tasks to the specific equipment identified.
   - Ensure that all electricians performing work on site are familiar with and comply with the site electrical safety policies. Include a specific reference to lockout/tagout requirements for all work that may expose live conductors.
   - Increase management and supervisory attention to worker compliance with posted safety requirements and barriers.
   - Emphasize to workers that if a procedure cannot be completed as written, it should be stopped and revised, rather than continue work.

2. **Improve implementation of the IWS process.** Specific actions to consider include:

   - Increase use of task-specific IWSs for Plant Engineering work.
   - Increase specificity of controls and increase attention to detail to ensure that all applicable hazards are identified and that adequate controls are in place prior to authorizing work.

- Pay particular attention to inclusion of controls identified on MSDSs and specific identification of PPE.

- Require an industrial hygiene review of the work site whenever respiratory protection may be considered to ensure that correct respirators are identified and used.

- Ensure that memoranda or other agreements between organizations are translated into appropriate procedures or included in the applicable IWS.

- Clarify expectations for the purpose and use of the pre-task hazards analysis form to ensure that specific requirements from IWSs are reviewed prior to work.

- Link tasks or activities to hazards and controls on blanket IWSs. Provide sufficient specificity and detail so that workers will not have to analyze hazards and establish controls for the first time when they are preparing a pre-task hazards analysis and/or safe plan of action form on the day a task is to be performed.

- Increase specificity of training requirements in IWSs. Specify course numbers for required training and more clearly identify the workers who must have the specified training.

- Better define PPE requirements. Replace statements such as "Use appropriate PPE" with control statements that clearly specify the type of PPE that must be used.

- Identify task-specific hazards earlier in the planning process to provide more time for involvement of line management and support organizations in identifying hazards and establishing controls.

- Include hazards and controls based on MSDSs so that workers will not have to interpret these documents.

- Restate procedure requirements in IWSs to the extent possible so that workers will not have to refer to these procedures. When procedures must be referenced, specify the procedure number.

3. **Establish clear policies and guidance on how work documents (e.g., technical and operating procedures and checklists) that support an activity described in an IWS are to be reviewed, revised, approved, and incorporated into the IWS process.** Specific actions to consider include:

   - Revise Document 3.4 of the ES&H Manual to provide greater clarity on the requirements for developing, approving, and issuing work documents.

   - Establish clear policies and guidance on how technical and operating procedures/checklists that support an activity described in an IWS are to be reviewed, revised, approved, or incorporated into the IWS process.

4. **Enhance the rigor with which experimental hazards are identified, evaluated, and documented.** Specific actions to consider include:

   - Clarify institutional guidance for the conduct and documentation of non-radiological exposure hazard evaluations (e.g., chemicals, noise, magnetic fields, confined-space atmospheres).

- Within the PAT Directorate, increase the rigor of documentation for non-radiological exposure hazards, ensure documentation of exposure evaluations, and integrate the results of the exposure evaluations with the IWS either directly or by reference.

- Ensure that the PAT Discipline Action Plan is reviewed when new hazards and/or controls are identified that may need to be identified and/or incorporated into the Discipline Action Plan.

5. **Ensure that hazard controls are well defined in IWS/safety plans and work documents and are tailored and linked to the hazard for which the control was intended**. Specific actions to consider include:

   - Increase the use of stand-alone IWS/safety plans in which the hazard control is clearly defined and linked to the hazard for which the control is intended.

   - Minimize the current IWS practice of cross-referencing hazard controls to other documents (e.g., ES&H Manuals, FSPs), which can result in confusion as to the identification of the appropriate control for the work activity.

6. **Establish and implement a mechanism within the IWS process such that required ES&H training can be clearly distinguished from recommended and phased training requirements.**

7. **Clarify the requirements for identifying, handling, storing and free-releasing radiologically "activated" materials.** Specific actions to consider include:

   - Revise ES&H Manual Document 20.2, *LLNL Radiological Safety Program for Radioactive Materials*, to include a practical definition for activated materials.

   - Revise the Building 194 FSP to clarify the requirements for identifying, labeling, storing, moving, and surveying activated and potentially activated materials.

8. **Implement procedures for all buildings to ensure that all workers (including LLNL employees, LSO personnel, visitors, etc.) in isolated areas, such as equipment rooms and ventilation plenums, can be accounted for during emergencies.**

9. **Conduct a review of current SOPs to ensure that requirements and expectations outlined in the ES&H Manual, OSPs, and IWSs are sufficiently applied at the working level.** Specific actions to consider include:

   - Identify and document potential hazards and controls to be implemented at the work step or activity level.

   - Provide additional training and guidance to SOP writers to ensure that ES&H Manual expectations are met.

   - Expand SOPs and/or guidance documents to address information on task-specific hazards, and document and verify controls that are specified and assumed to be in place at a given facility.

LLNL – NMTP

1. **Increase emphasis and resources in Building 332 toward conduct of formal ALARA reviews as required by the ES&H Manual, including documenting and tailoring specific radiological and ALARA controls within all OSPs that govern high-dose work.** Specific actions to consider include:

   - Determine root causes for failure to conduct proper ALARA reviews as required, and place greater management priority toward identifying and correcting these deficiencies.

   - Consider adding a position within ES&H Team 1 for a radiological engineer or radiological work planner whose duties include ALARA reviews, radiological work planning, ensuring an appropriate level of specificity of radiological controls within OSPs, and assisting with OSP training in the area of radiological protection.

   - Consider developing a work instruction or procedure that outlines specific expectations for content and format of formal operational ALARA reviews and that demonstrates a systematic approach to review and development of radiological controls.

   - Consider developing and using an ALARA review checklist to identify those areas that must be considered and documented as part of the ALARA review process.

2. **Increase attention to development of more detailed work instructions and additional technical basis documents to ensure that health physics expectations are clearly delineated and can be carried out in a justifiable and consistent basis.** Specific actions to consider include:

   - Consider developing more detailed work instructions for health and safety technicians to outline expectations for completing field duties, such as operational checks of the hand and foot monitors, hand and foot checks, and air sampling.

   - Consistent with DOE expectations and guidance, consider developing additional technical basis documents for the radiation protection program in the areas of air sampling such that technical defensibility of methods, instrumentation, and implementation methods can be defined and demonstrated.

3. **Increase the level of detail applied to identification and documentation of radiological hazards and specification of controls on work permits.** Specific actions to consider include:

   - Ensure that all hazards, such as the production of secondary radiation and the potential for unanticipated hazards when dealing with waste materials, are called out in work control documentation or provide an appropriate justification for their absence.

   - Ensure that radiological controls, such as swipe testing, are specified with sufficient detail to ensure that hazards, such as the spread of contamination, cannot go undetected when personnel leave workstations.

4. **Enhance Building 332 work control requirements to ensure that an abnormal event response receives the appropriate level of hazards analysis.** Specific actions to consider include:

   - Revise the Plutonium Facility – Building 332 Work Control/Design Control Change Process Manual (work control manual) to ensure that recovery actions from large contamination events and other abnormal events are reflected as Category D activities.

   - Clarify the list of types of Category A activities in the work control manual to ensure that cleanup activities following the initial response to abnormal events cannot be considered Category A activities.

   - Perform a review of the work control manual to ensure that it correctly matches all work control assumptions in the current safety analysis report. Perform the same review against the documented safety analysis currently being reviewed by LSO for approval.

LLNL – PAT

1. **Reassess the work-authorization-level classification of some research maintenance activities and facilities (e.g., machine shops).** Specific actions to consider include:

   - If these activities exceed the Level A classification, ensure that the work and associated hazards and controls are documented in an IWS.

   - Establish a list of typical research activities within the PAT Directorate that require an IWS.

LLNL – Maintenance

1. **Improve control of unique electrical equipment and the building electrical system configuration to ensure compliance with site requirements.** Specific actions to consider include:

   - Modify the low-voltage outage permit procedure to clearly assign responsibility to the Maintenance Technical Administration Group for review of modifications to building electrical systems to ensure that proposed modifications will meet the National Electrical Code.

   - Specify an inspection requirement in work requests (either Form 1 or a whiz tag request) that modify electrical systems to ensure that the installation meets code.

   - Revise ES&H Manual, Volume 2, Section 16.3, to better clarify expectations for inspections of electrical equipment. Designate electrical inspectors, rather than Authority Having Jurisdiction field representatives, to better reflect management expectations that electrical code interpretations will be referred to either the Building or Program Authority Having Jurisdiction.

LLNL – Construction

1. **Improve training for construction supervisors and workers.** Specific actions to consider include:

   - Provide training to LLNL and GSE workers on their responsibilities for implementing the LLNL work control process. Include detailed guidance on developing pre-task hazards analysis work sheets and safe plans of action.

- Continue efforts to add formality and rigor to the GSE safety training program. Track GSE training in the appropriate database (LTRAIN).

- Establish clear expectations in training and procedures for use of MSDSs.

2. **Improve construction safety programs and procedures.** Specific actions to consider include:

   - Improve LLNL procedures for developing pre-task hazards analyses. Specify the documents that should be reviewed to identify hazards and controls and provide guidance on the extent to which hazards that may be encountered should be included in a pre-task hazards analysis.

   - Require supervisory approval of safe plans of action and pre-task hazards analyses.

   - Establish contract requirements, and continue to work with construction subcontractors to achieve construction subcontractor worker involvement in the identification of hazards and controls.

   - Continue efforts to update Plant Engineering procedures for construction management and inspection. Establish a formal process to identify, document, and periodically evaluate safety performance. Consider periodic meetings with construction subcontractor management to discuss results and convey expectations.

   - Ensure that GSE establishes procedures for development and use of safe plan of action forms.

   - Ensure that construction subcontractors have the capability to assess worker exposures for compliance with American Conference of Governmental Industrial Hygienists threshold limit values, or provide this support from LLNL ES&H teams.

   - Consider issuing ES&H Manual requirements instead of sitewide HAC forms and IWS changes instead of job-specific HAC forms. If the HAC forms process is retained, add formality and rigor by assigning identifying numbers to HAC forms and providing requirements in the ES&H Manual for their content, format, and use.

3. **Improve flowdown of requirements to subcontractors.** Specific actions to consider include:

   - Update the GSE contract to reflect current expectations and practice regarding GSE use of LLNL procedures and permits.

   - Include Work Smart Standards requirements for worker involvement, worker rights, exposure assessments, and American Conference of Governmental Industrial Hygienists threshold limit values in future construction subcontracts. Consider adding these requirements to existing contracts.

   - Change construction subcontracts as necessary to assure that the subcontractors have the capability to assess worker exposures.

LLNL – Waste Management

1. **Increase the rigor of application of the IWS process and labeling functions for waste management facilities and activities.** Specific actions to consider include:

    - Evaluate IWS documents to ensure that all hazards are identified and that necessary controls have been implemented for waste management operations.

    - Ensure that materials with an expected future use are properly managed so they can be readily located or identified for disposal if it is determined that the material is no long needed.

    - Ensure that Waste Generator Services personnel are involved during the planning for projects that will generate a waste stream so that appropriate controls can be applied.

    - Ensure that machine tools and power-actuated tools, including those relocated as a part of waste management cleanouts, have all required safety equipment.

2. **Focus management attention on the schedule for implementing and self-certifying the environmental management system as required by Executive Order 13148.**

LLNL – Environmental Restoration

1. **In addition to ES&H team facility-based reviews, formalize requirements for ES&H team involvement in assessment of activities at field locations.** Specific actions to consider include:

    - Establish a set of ERD operations or tasks and require these activities to be included in the ES&H team assessment baseline.

    - Establish formal guidance for ES&H team review and approval of SOPs.

    - Document required follow-up actions from ES&H team reviews and provide administrative controls, such as procedural hold points, to ensure future compliance.

2. **Increase efforts to ensure that identified hazards are meaningful, are conducted at the appropriate risk level, and incorporate appropriate controls.** Specific actions to consider include:

    - Subdivide the IWS or develop a new IWS to narrow the suite of potential hazards to those activities or geographic areas where hazard potential actually exists.

    - Attach documentation, such as an industrial hygiene exposure assessment or hot work or dig permits, to work packages to document the results of ES&H team reviews.

    - Ensure that a narrative description of the technical basis for proposed action levels is documented or incorporated into work history.

3. **Increase the rigor associated with evaluation and implementation of breathing zone air monitoring controls to ensure that representative sampling is conducted for drilling operations**

or jobs that involve respiratory protection and/or the potential for airborne releases. Specific actions to consider include:

- Evaluate current drilling geologist training and frequency to determine whether it is adequate, to ensure that they have the knowledge and skills necessary to consistently evaluate and implement workplace air sampling requirements.

- Provide additional guidance to drilling geologists concerning implementation of job-specific air sampling.

- Consider using a personal air sampler for those jobs where other methods of direct measurement may be infeasible.

APPENDIX D

Core Function #5 – Feedback and Continuous Improvement

D.1 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Independent Oversight and Performance Assurance (OA) evaluation of feedback and improvement at the Lawrence Livermore National Laboratory (LLNL) included an examination of the DOE Livermore Site Office (LSO) and LLNL environment, safety, and health (ES&H) programs and performance. The OA team examined LSO line management oversight of LLNL integrated safety management (ISM) processes and implementation, including the operational awareness program; annual and "for cause" ES&H program evaluations; and the award fee/performance evaluation and measurement process. The OA team also reviewed LLNL institutional processes, such as assessments and inspections, corrective action/issues management, injury and illness investigation and reporting, lessons learned, the employee concerns program (ECP), and activity-specific processes, such as post-job reviews.

D.2 RESULTS

D.2.1 LSO Line Management Oversight

DOE Headquarters

The National Nuclear Security Administration (NNSA) has primary responsibility for LLNL. Roles, responsibilities, and authorities for ES&H/landlord management flow from the DOE Functions, Responsibilities, and Authorities Manual (FRAM), through the NNSA FRAM, to the LSO FRAM. NNSA and LSO managers communicate regularly, including several weekly phone calls between the senior managers. Additionally, LSO provides a monthly report to the NNSA Office of the Administrator (NA-1) detailing activities at the LLNL site.

The Office of Environmental Management (EM) has line management responsibilities for certain environmental restoration and waste management activities at LLNL. EM and LSO have not established the required memoranda of understanding to define the respective responsibilities and interfaces. As identified in an LSO fiscal year (FY) 2003–2004 ES&H self-assessment, the memoranda of understanding between LSO and NNSA, the Nevada Site Office, and the Office of the National Ignition Facility were also outdated. Actions are under way to revise these memoranda (see Finding #8).

In October 2006, NNSA will assume responsibility for waste and environmental management activities at the LLNL that are currently under the cognizance of EM. Interviews with NNSA Headquarters managers indicated that NNSA and EM are being proactive in managing this transition. LLNL restoration and waste management activities have been effectively briefed to NNSA managers in order to provide an understanding of the work involved and the challenges at LLNL in both waste management and restoration activities. NNSA management was knowledgeable on items that need monitoring, such as a number of items that currently have no viable disposal pathway (see Appendix F).

LSO

LSO line management oversight is in a state of transition based on two major factors. First, LSO is adapting to the major NNSA reengineering effort, which created site offices and a service center and shifted numerous organizational responsibilities. LSO is responsible for many activities previously performed by the Oakland Operations Office and has considerable work to do to establish LSO functions, revise and update procedures, and other such activities. Second, LSO, in coordination with LLNL, is working to develop the Line Oversight/Contractor Assurance System (LOCAS), based on NNSA direction and guidance. At this stage, LSO has developed a standard operating procedure (SOP) for line management oversight under the NNSA LOCAS, but has not yet implemented it. LSO has considerable upcoming work to review the LLNL contractor assurance system documentation (when delivered by LLNL), train LSO staff on the LOCAS, and address information technology challenges.

LSO Oversight Program. LSO has made progress in developing oversight program direction and guidance, such as its FRAM and SOPs. The new LSO FRAM is adequate and is being maintained current. Various SOPs have been developed and approved, and others have been drafted and are undergoing review.

However, in part because of the NNSA reengineering, many aspects of the LSO program are not fully functional or need revision to reflect current operations. Roles, responsibilities, and authorities for ES&H and quality assurance are not always clearly defined and communicated to LSO staff. A significant number of LSO position descriptions are in need of revision (i.e., of 20 reviewed by OA, 11 do not reflect the current organization or processes, and 7 do not reflect current responsibilities). A number of LSO procedures are being revised as a result of an LSO self-assessment but are not fully implemented or have not been validated to be effective. A number of other procedures do not reflect the current organization or processes or are still in draft. Service-level agreements with the NNSA Service Center have not been revised at the schedule specified in the LSO FRAM, and LSO and the Service Center do not have an agreement that addresses their respective roles, responsibilities, and authorities for interfaces. LSO does not have a quality assurance plan as required by DOE Order 414.1B, *Quality Assurance*. The LSO draft quality assurance plan was forwarded for NNSA approval in July 2004.

Finding #8. Important elements of the LSO line management oversight program are not fully established or effectively implemented in the areas of memoranda of understanding, clear responsibilities and authorities, standard operating procedures, assessment schedules, employee concerns programs, the lessons-learned process, technical qualifications, and document storage.

LSO Operational Awareness. In the interim, until the LSO LOCAS is fully defined and implemented, LSO has defined a system of operational awareness activities, and an operational awareness SOP was approved. LSO management routinely meets with LLNL management to discuss ES&H concerns. A few LSO organizations are meeting most of the minimum requirements for operational awareness activities as defined in the operational awareness implementation plans (OAIPs); an SOP requires each organization to develop an OAIP to define individual and organizational expectations. Operations Team #1 (Superblock) demonstrated the most technical rigor and quality, and performed 94 operational awareness activities that identified a significant number of anomalies. The nuclear safety team OAIP personnel met the minimum requirements in most cases, and the technical quality of their OAIP was generally adequate.

However, there are weaknesses in processes and performance in several LSO organizations. One division and three of seven operations teams have not developed an OAIP, as required by the SOP. For some organizations that have the required plans, the minimum requirements defined in the plans are not being met. As examples:

- One OAIP identifies minimum and stretch goals for LSO senior management walkthroughs in LSO facilities. Based on a review of the documentation contained in the FISHE database, the primary LSO ES&H issues tracking system, one of nine LSO senior managers met the minimum number of operational awareness activities required. LSO managers indicated that, in some cases, walkthrough reviews were conducted but not documented in FISHE.

- In the National Security Implementation Division, only two of eleven staff members met the minimum requirements defined in the OAIP.

- The Environmental Stewardship Division does not have an organizational OAIP. There is an OAIP for Operations Team #6 (Environmental), but four of eight personnel did not meet minimum requirements, and few personnel identified and reported deficiencies.

- Less than half of the 21 personnel in the Livermore Safety Operations Division met the OAIP minimum requirements, and the technical quality for most FISHE entries was not adequate.

- Operations team quarterly reports are not always completed and routed for senior management review.

- Similar weaknesses were identified with Operations Team #4 (Defense, Science, and Institutional Programs) and Operations Team #7 (Nonproliferation, Counter Terrorism, Intelligence, and Biological).

Finding #9. LSO operational awareness activities, assessments, Facility Representative reviews, and issues management processes are not sufficiently rigorous to ensure continuous improvement in LLNL ES&H programs and performance.

Facility Representative Program. The Facility Representative program is functioning but lacks consistency and rigor. Facility Representatives are identifying deficiencies, as evidenced by the entries to FISHE. The assignment of LSO Facility Representatives to the LSO operations teams enhances coordination and the overall effectiveness of LSO line management oversight.

However, the quality and rigor of LSO Facility Representative reviews are inconsistent. A review of the Facility Representatives' operational awareness entries in FISHE indicate that the Facility Representative reviews are not consistently performed with sufficient quality, depth, and rigor. In addition, LSO Facility Representatives have responsibilities for evaluating safety systems and the authorization basis at the nuclear facilities; the rigor and depth of Facility Representative reviews of safety systems is not sufficient based on the numerous deficiencies in safety system procedures, testing, surveillance, technical safety requirements, and operating procedures (see Appendix F). Conversely, Facility Representative bi-weekly reports included considerably more technical content than the FISHE database entries (see Finding #9).

While the Facility Representative program has some adequate processes, some elements of the program are not well defined or are not fully implemented. The Facility Representative program SOP and training manual are not reflective of the current organization or processes. The need to update these documents was identified as a deficiency in the FY 2003-2004 ES&H self-assessment, but corrective actions are overdue. Reporting practices are also in need of improvement. The quarterly reporting is generally limited to performance metrics and does not sufficiently address Facility Representatives' issues, such as the material in bi-weekly reporting (see Finding #8).

Assessment of LLNL ES&H. LSO has conducted a number of quality assessments of LLNL ES&H topics (i.e., the LLNL embedded work process review, and the LLNL criticality safety program review). However, there are weaknesses in the processes for performing formal assessments of LLNL ES&H topics, and the technical quality of the reviews varies. LSO has not determined functional area review periodicity (in accordance with DOE and LSO directives), as required by the LSO ES&H assessments and reviews SOP. Without a structured approach (such as a master assessment schedule), LSO's ability to plan and coordinate staff resources and obtain NNSA Service Center and external support is limited (see Finding #8).

In addition, reviews and follow-up actions are not always timely or effective. For example, the LSO review of the baseline inventory of beryllium operations was conducted in December 2003, but the corrective action plan (CAP) was not approved at the time of the OA inspection. Similarly, LSO has been working on LLNL open actions associated with an authorization basis CAP since July 2000. Additionally, LSO radiological controls assessments have not been conducted since 2001. Staffing issues have contributed to this weakness (the former LSO health physicist has accepted another position and his replacement is awaiting his security clearance). The NNSA Service Center has not been requested to provide support for programmatic assessments (see Finding #9).

LLNL Contract Performance Evaluation. The DOE/University of California (UC) contract includes the appropriate clauses (e.g., performance-based management clause, and program performance fee definition, including the fee for ES&H deliverables). Similarly, appropriate ES&H provisions are reflected in the FY 2003 and FY 2004 Appendix F, Standards of Performance; the ES&H section of the FY 2003 Annual Performance Evaluation and Appraisal Report; the FY 2004 Assessment Management Plan; and the ES&H section of the FY 2004 LLNL Appendix F, Self-Assessment. For FY 2003, LSO appropriately used the contract performance evaluation process to hold UC accountable and to promote improvements in ES&H performance. LSO downgraded LLNL's 2003 performance rating to "satisfactory" in the operations category (which includes ES&H criteria), largely due to ES&H performance issues. This resulted in a reduction of about $1 million in the award fee.

However, the effectiveness of LSO's evaluation of LLNL contract performance is hindered by the insufficient technical quality of the ES&H operational awareness and assessment activities (as discussed above). In addition, LSO does not have a formal procedure for the conduct of the evaluation of contractor performance. Some guidance has been developed, and a procedure has been drafted but has not yet been used (see Finding #8).

LSO Issues Management. LSO issues management and corrective action tracking is currently operating at various levels of effectiveness. Although not institutionalized through an SOP, the nuclear safety team has strong tracking tools for LSO and LLNL authorization basis items. In addition, LSO recently developed a process and a draft procedure for evaluating ES&H performance measures and metrics, and has completed its first report. When fully implemented, this process has the capability to be an effective tool for LSO management for evaluating ES&H status and issues.

However, the issues management program is not fully functional. Roles and responsibilities for corrective action tracking are not clear. Each division in LSO has their own practices for tracking issues and corrective actions (at least six informal systems are currently in use). The multiple systems make meaningful review of trends very difficult. In addition, several issues management procedures are not yet approved, provide inconsistent guidance, or are not yet implemented. For example, the LSO verification and validation SOP has not been approved or implemented, and corrective actions are not currently being effectively tracked, verified, or validated (see Finding #8).

LSO Self-Assessment. The LSO self-assessment SOP (Level 1) was approved on September 21, 2003. This SOP is consistent with NNSA guidance (draft dated April 29, 2004) and when implemented should improve the LSO self-assessment program. The SOP requires the development of plans and schedules for the accomplishment of identified self-assessments. The FY 2003-2004 ES&H self-assessment is a high-quality and self-critical review of the LSO ES&H program, and meets the intent of the NNSA guidance and the LSO self-assessment SOP. This self-assessment identified most of the deficiencies identified during this OA assessment.

However, the LSO self-assessment program is not yet mature or consistently implemented. An ES&H self-assessment SOP (Level 2) has been drafted but does not address scheduling of ES&H assessments. Similarly, LSO has drafted and approved an ES&H FY 2005 self-assessment plan, but this plan lacks schedule information. A Federal Employee Occupational Safety and Health (FEOSH) self-assessment was conducted in May 2003, but no CAP was produced. The LSO FEOSH Manual requires annual assessment, but no FEOSH self-assessment was conducted in FY 2004 because of conflicting priorities. Some of the corrective actions for the LSO ES&H FY 2003-2004 self-assessment are overdue, and LSO has been unable to fully verify or validate some corrective actions. LSO is required to perform a self-assessment of the Facility Representative program every three years. LSO did not complete such a self-assessment in FY 2004. The last self-assessment of the LSO Facility Representative program was completed in March 2001; the CAP for this self-assessment was not issued for over a year (June 2002), and tracking and completion of the corrective actions have not been rigorous (see Finding #8).

Lessons Learned. LSO has developed and is about to implement its lessons-learned program. The lessons-learned SOP was approved on October 6, 2004, and provides the framework for an adequate process. LSO has appointed a lessons-learned manager and divisional coordinators. LSO has not yet provided training on the lessons-learned program to its managers and staff (see Finding #8).

LSO Technical Qualification Program (TQP). The LSO TQP has a number of positive aspects. The LSO TQP SOP provides clear direction and generally meets the NNSA guidance on the TQP and applicable DOE orders and manuals. The LSO Technical Qualification Committee has been established, with a clear charter, and meets as required to guide implementation of the TQP. The LSO Lead Systems Engineer has developed a safety systems oversight functional area qualification, and seven LSO staff members are in the process of qualifying to the standard.

LSO has not conducted a self-assessment of the training and qualification program (Federal or TQP) since FY 2000, and has not developed a site-specific qualification standard. There are at least seven technical personnel in LSO who are not in the TQP, but appear to meet the test in DOE Manual 426.1-1A, *Federal Technical Capability Manual*, for inclusion in the TQP. Operations team leaders for five of the seven operations teams are not in the TQP (see Finding #8).

Employee Concerns Program. The LSO ECP is not currently operational. Prior to the NNSA reengineering effort, the Oakland Operations Office operated an ECP; however, that ECP appears to have been abandoned in place and is not functional (see Finding #8).

LSO recognizes the need to reestablish an ECP and is taking action accordingly. LSO has drafted an employee concerns SOP. However, the draft procedure does not fully meet the requirements in the LSO procedures development process SOP. The ECP Manager indicated that he is in the process of getting a phone line and answering machine in place, and plans to order posters as soon as phone/answering machines are operational.

Documents and Records. Some documents and records are not being stored in accordance with requirements. Roles, responsibilities, and authorities for records and document management are not well understood, and each division controls documents and records differently (see Finding #8).

LSO is taking action to enhance document and record management, most notably through its "Sharepoint" document control system. LSO recently completed an interim SOP for this system, which was approved on August 30, 2004. This SOP provides an adequate basis for the document and records management program but is not fully implemented across LSO, and access to the Sharepoint program has been sporadic. NNSA is considering implementation of an NNSA-wide document and record management system, which may replace the LSO system.

D.2.2 LLNL

Feedback on the adequacy of ES&H processes and performance at LLNL is provided by a variety of processes that result in continuous improvements to safety performance. Structured inspection and assessment processes evaluate facility conditions, processes, and performance at the department/division, directorate, and institutional levels. Many deficiencies and safety issues are formally evaluated and tracked to resolution with an institutional issues management tool. Other feedback mechanisms for improving ES&H performance include injury and illness investigation and reporting, the occurrence reporting and processing system (ORPS), lessons learned, employee concern/suggestion programs, and safety committees.

As discussed below, elements of these feedback and continuous improvement programs are well designed and being effectively implemented and reflect improvements since the 2002 OA inspection. However, little progress is apparent in several areas, and weaknesses in processes and implementation are limiting the effectiveness of these feedback and improvement programs.

Assessments. The LLNL ES&H Manual and the Quality Assurance Program Plan establish the requirements for directorate-level ES&H self-assessment programs and institutional-level independent assessments by the Assurance Review Office. The ES&H Manual assessment procedure was revised to focus assessment on the effectiveness of the ES&H program and to provide more guidance and direction to improve the quality and consistency of self-assessment plans and performance reports. These documents address facility safety inspections, independent and management assessments, management walkthroughs, and an annual assessment of performance in implementing the objectives and performance measures in the management and operating contract with DOE.

Annual self-assessment plans are developed and published by each directorate, many divisions and departments, and the Assurance Review Office. A number of different assessment activities are conducted to evaluate safety performance and the implementation of ISM guiding principles and core functions at LLNL. Subject matter experts on the ES&H teams or contractors perform periodic facility condition inspections, typically triennially for non-nuclear facilities and annually for nuclear facilities. Most facilities are inspected more frequently, typically annually, either by the ES&H teams or by directorate safety personnel. ES&H teams also conduct routine industrial safety, industrial hygiene, radiological protection, fire protection, and environmental surveillances, inspections, and monitoring to assure compliance with LLNL, DOE, and regulatory requirements. Representatives from Plant Engineering and an ES&H team routinely inspect construction sites and activities to evaluate health and safety performance.

Most formal ES&H team facility inspections are not documented on a formal report by the ES&H teams or the line organizations; however, a list of deficiencies is provided to the directorates, and the deficiencies are entered into the Issues Tracking System (ITS), a new web-based system that provides a vehicle to track assessments and the resulting issues and corrective actions. One exception noted by the OA team was the recent Hazards Control Team 3 inspection of Building 230, Building 231, and Building 231 Vaults, which identified 181 items that were entered into ITS. The Assurance Office for Engineering published a comprehensive report that described the scope and results and reflected interviews with workers and review of integration work sheet (IWS) documents.

The institutional ES&H Working Group has identified topical focus areas that directorates are required to consider for applicability to their facilities and operations and to include in their annual self-assessment plans as appropriate. The current focus area list contains 24 functional areas, including several management systems, criticality safety, fire protection, injury and illness, several industrial hygiene and industrial safety areas, and waste management. Each directorate also conducts an annual assessment of the implementation of ISM by completing a standard matrix of guiding principle and core function attributes and lines of inquiry. Directorates generate an annual ES&H performance report that summarizes the status and progress for various elements of their ES&H programs, including self- and external assessments, management and worker involvement, the ISM matrix, reportable events, and the status of corrective actions. Managers are expected to participate in self-assessment activities, and there is evidence that some managers are performing management reviews and conducting periodic walkthroughs of work areas.

The Assurance Review Office conducts several independent assessments related to safety processes annually, generates reports to management on extensive analysis of data from the deficiency tracking system and from ORPS reports, and issues an annual rollup LLNL-wide ES&H Assurance Report from the individual directorate ES&H performance reports. The Assurance Review Office independent assessments were comprehensive and documented in detail. These assessments and reviews identified directorate and institutional-level issues that were tracked in the site deficiency tracking system and in some cases the Price-Anderson Amendments Act Noncompliance Tracking System. The Assurance Review Office assessments and reviews provide continuing, independent feedback to LLNL senior management for use in improving safety performance.

Although many self-assessment activities are performed by LLNL (including internal independent assessments), some weaknesses were identified that reduce their effectiveness. Assessment process implementation requirements and expectations are not always adequately defined, some assessments lack sufficient depth and focus to effectively evaluate the adequacy of ISM implementation, and some required assessment activities are not being performed. In addition, issues identified by LLNL assessment activities are not consistently and effectively evaluated and resolved (discussed below). Although Document 4.1 of the ES&H Manual generally describes the elements of an effective self-assessment program, LLNL management has not established sufficient feedback mechanisms to ensure that this program is being effectively implemented. Examples of weaknesses identified in the LLNL assessment programs include the following:

- **Self-assessment plans are not being sufficiently tailored to the specific activities and facilities of directorate organizations.** While the directorates are properly conducting assessments of the institutionally identified focus areas, which promotes an element of commonality among directorate self-assessments and provides greater assurance that key functional areas are evaluated across the site, few other assessment topics are being identified for assessment that reflect unique activities, facilities, or prior areas of weakness of these organizations. For example, Nuclear Materials Technology Program (NMTP) assessment plans have not sufficiently included such topics as design, safety basis, and operations observation assessments that could have identified the process and performance deficiencies identified by OA, as discussed in Appendices D and F of this report.

- **Many assessments lack the depth, rigor, and focus on performance and safety program implementation necessary to effectively measure the adequacy of processes and performance.** The focus of many assessments was on the "what" and "how" of safety processes rather than the adequacy of the process or its implementation. There was little evidence that assessments included work observations and examination of records and documents, and thus they did not meet LLNL procedure requirements or DOE ISM expectations. For example, the ISM assessment matrix questions and directorate/department answers related to hazards and controls are limited to IWS documents and do not address documents referenced on the IWS and other documents that also specify identified hazards and controls, such as facility safety plans, operational safety plans, and work permits. The directorate ISM assessment reports issued this year and the site's recent Assurance Report all indicate perfect or near perfect compliance with these criteria, which is not in consonance with the observations of the OA team, reflecting either inadequate evaluation criteria or insufficient rigor, or both.

- **Many safety programs have not been evaluated for adequacy of the processes and implementation on an institutional level.** In some cases, these topical areas are part of the assigned focus areas and are reviewed by the individual directorates, but they are not being evaluated by the program owners for sitewide adequacy. For example, although addressed individually by the directorates as focus areas, the injury and illness investigation and reporting program and pressure safety program, which are required by the ES&H Manual, have not been assessed at an institutional level for many years. LLNL has not formally assessed the implementation of management systems, such as the self-assessment program, issue/deficiency management, lessons learned, and training, from a sitewide perspective. In addition, the LLNL assessment program lacked sufficient rigor to identify significant process and performance deficiencies in several other important ISM areas identified by the OA team (e.g., IWS hazard identification and controls, procedure quality and adherence, essential system design, and operations).

- **Some assessments are poorly documented, are not documented in a timely manner, or are not documented in reports as required by the ES&H Manual.** A number of reports for the LLNL Physics and Advanced Technologies (PAT) Directorate assessments conducted in 2003 were not issued until approximately a year later in 2004. A December 2003 assessment was still in draft form. Some management assessments were documented in bullet format on presentation slides rather than the reporting format required by the ES&H Manual procedure. In some cases, identified weaknesses or deficiencies were not pursued to establish the extent of the condition or to determine whether process deficiencies resulted in performance or hardware deficiencies. For example, recent pressure safety systems assessments in the PAT Directorate and Environmental Protection Department (EPD) identified numerous deficiencies in the tracking tool that identifies pressure systems and devices at LLNL, but failed to identify these errors as deficiencies or issues for follow-up and correction at the institutional level. The EPD assessment did not state that testing and inspections were current for the assessed systems. The PAT assessment concluded that there was no evidence that errors affected assessed systems. However, the ITS reflects that in the two months prior to this assessment, three pressure systems were overdue for inspection and testing. In addition, the ITS reflected that eight gas cylinder relief valves had been identified as overdue for testing in the two months prior to the assessment, although the relief valves were not specifically included in the scope of the pressure safety assessment. Many reviews, assessments, and walkthroughs by line management were not well documented. Management participation in assessments is not reflected in the available documentation. Institutionally, walkthroughs, other than formal ES&H team facility inspections, are not being documented or are documented without sufficient details regarding what was assessed, when, and with what results.

- **Inspectors from Plant Engineering provide oversight of construction safety, but inspection data is not systematically recorded or analyzed.** For construction activities performed by LLNL and its subcontractors, oversight is provided by inspectors who are assigned to review safety and quality assurance aspects of construction activities. For activities performed by an LLNL construction subcontractor (i.e., GSE), the oversight is performed by Plant Engineering construction coordinators in conjunction with their project management responsibilities. Procedures for inspection and construction coordination activities have not been updated in several years, are not consistent with the current organizational structure, and are not strictly followed. Plant Engineering has identified the need to update these procedures. Plant Engineering uses a "coaching" approach to achieve compliance with safety requirements and does not normally inform contractors in writing of deficient conditions unless the deficiencies remain uncorrected after informal notification or are of unusually high significance. Safety observations are documented on daily report forms maintained by Plant Engineering, but there is no formal process to periodically analyze this data or to formally communicate with construction subcontractors regarding noted deficiencies or trends.

- **The substance and significance of many conclusions and characterizations of deficiencies cited in Assurance Review Office reports and assessments have not been clearly delineated. In addition, LLNL management has failed to capitalize on the analysis and data provided in these reports by not formally addressing the findings and information provided.** The 2003 assessment of ISM implementation of the IWS process had nothing but positive conclusions, including the evaluation of IWS-specified training, even though directorate ISM self-assessments were identifying that IWS-specified training was an area needing improvement. The recently issued Annual ES&H Assurance Report identified that 11 of 28 possible scores related to IWS training (14 organizations and two attributes) were scored by directorates as yellow (needing improvement) and another was scored as red (significant weakness). The detailed March 2004 Deficiency Tracking System Annual Report identified a number of statistics alluding to some adverse trends and weaknesses or to areas needing further evaluation to establish whether a problem existed or not. However, it did not clearly detail the issues, and LLNL management has not conducted further analysis to address the questions raised in this report.

The Annual ES&H Assurance Report issued in August concluded from an analysis of directorate integrated safety management system (ISMS) self-assessments that "two areas stand out as having numerous yellow and/or red scores which indicate weaknesses in the areas of Balanced Priorities and Competence Commensurate with Responsibilities." It also concluded from an analysis of external and independent report findings and ORPS reports that the analysis "indicated areas for improvement in the ISM areas of Developing and Implementing Hazard Controls and also Performing Work within Controls." There was no discussion of the apparent differences in these conclusions and there is no evidence that LLNL management has yet addressed the summary statements in this report from an institutional perspective. The Assurance Review Office's 2004 (May and August) semi-annual and quarterly ORPS reports provided substantial data related to potential program weaknesses and recurring issues, but lacked clearly defined conclusions or recommendations. Site management held a meeting in September 2004 to discuss the Assurance Review Office reports on ORPS reporting and identified several issues that met the occurrence reporting criteria of DOE Guide 231.1-1 as reportable recurring problems. However, the decisions resulting from that meeting were not formally documented, and no actions have been taken to initiate occurrence reports for these issues. In addition, the authorization basis CAP closure assessment of April 2004 identified that 5 of 13 actions from the CAP were not complete, although they had been identified as closed by the LLNL Authorization Basis Section. However, the findings were inadequately characterized by the Assurance Review Office as "the corrective actions could not be verified as completed" and were identified as individual concerns and opportunities for improvement, when the real issues were that Price-Anderson Amendments Act CAP actions had been closed improperly or that changes to the CAP had not been subjected to proper configuration management. Although this was a rigorous and substantive assessment and the identified concerns and opportunities for improvement were entered into ITS, the underlying issue of inappropriate closure was not identified in ITS to be formally addressed by management. The executive summary identified the lack of information to verify closure and confusion as to the alignment of an authorization basis self-assessment and the CAP wording, but did not clearly state that the CAP action items had been improperly closed or that changes to the CAP had not been formally documented and approved.

Finding #10. The LLNL self-assessment program lacks sufficient rigor in planning and execution to be fully effective in evaluating ES&H performance.

Issues and Corrective Action Management. Improvements have been made in the tool for documenting and tracking issues and deficiencies that can promote the use of the institutional tool and provide more visibility and manageability for these items, but the tool is still not fully functional, and implementation is in its infancy. The new ITS is a more user-friendly tool for managing ES&H deficiencies and issues. Its tree format provides a logical, visual presentation of the source, condition, and corrective actions. Each deficiency is assigned one of approximately 400 compliance categories (i.e., specific descriptors in environmental, management, and health and safety areas). Each deficiency is also assigned one of the following priority levels: imminent (priority 1A), substantial (priority 1B), significant (priority 2), minor (priority 3), or minimal (priority 4). This information will support data analysis and provide a means to apply the graded approach to the application of resources and emphasis in addressing safety problems.

LLNL has rolled over the historical DefTrack items into ITS to provide for continuity and data for trending. The tool will allow the attachment of hot links to source documents and to other supporting documents, including those providing evidence of action completion. Crosscutting institutional ES&H issues and actions are now being documented and tracked in ITS. Most deficiencies identified in assessments are being appropriately logged into ITS. Many corrective actions for many ES&H deficiencies and issues are adequately tracked to resolution through a variety of informal and formal processes. The Plant Engineering and Security Departments are employing formal management reviews and incident analyses to investigate operational incidents that do not meet the reportability thresholds of ORPS.

However, weaknesses remain in the process and in the management of deficiencies and issues. The documentation, evaluation, and resolution of ES&H deficiencies and issues are not being managed in a consistent and effective manner that fully supports continuous improvement. Examples of weaknesses are discussed in the following paragraphs.

The revised ES&H Manual Document 4.2, *ES&H Deficiencies Management,* contains a number of ambiguities and other weaknesses that reduce its value as a management tool. The entry of deficiencies into ITS appears to still be based on their source rather than the substance of the deficiency. The procedure states that ITS is used to "report and document" assessments performed by the directorate that are *scheduled in its self-assessment plan* (emphasis added) in addition to assessments by external organizations. It does not clearly address self-assessments by subordinate organizations (divisions, departments), assessments that may not be put on the schedule, or deficiencies identified by means other than formal assessments. In addition, only the priority level 3 deficiencies that are from "scheduled directorate level" assessments or that are repetitive, mandatory, or noteworthy—all undefined terms—are required to be put into ITS. The terminology and the number of priority levels are inconsistent between the text in ES&H Manual Document 4.2 and the new ITS process. The procedure appropriately states that causes of deficiencies are to be determined and addressed, but does not provide any specific fields for cause codes or guidance on documenting causal determinations. The procedure does not provide direction for ensuring that the extent of condition is identified for deficiencies. The procedure maintains unnecessary limitations on access to ITS data; it identifies what has to be "released" to a laboratory view and provides a minimal number of viewers with authorization to view institutional issues. None have been released to the laboratory view to date. The previous tracking tool had a number of barriers to accessing deficiency and issue information that hindered effective issues management and that have not been adequately addressed. The identification of priority levels and compliance codes is not specified as an action step in the text or flowcharts of the procedure.

The institutional process in ES&H Manual Document 4.6, *Incident Analysis Manual*, contains institutional guidance for incident analysis but lacks sufficient guidance and direction for conducting and documenting analysis and for developing preventive actions for operational and work-related incidents of lower significance that do not meet ORPS reportability requirements. Although there is evidence that some level of formal incident review is being performed by the directorates, the thresholds or expectations for investigating, documenting, and managing these incidents is not defined at the institutional or directorate level.

Implementation of the deficiency management process is not always consistent or appropriate. The NMTP feedback and improvement plan has not been revised since October 2001, and NMTP procedures still allow 45 days to correct priority level 2 and 3 deficiencies identified during facility inspections before they must be input to ITS. The documentation and description of deficiencies and corrective actions in ITS is inconsistent and often lacks sufficient rigor. For example, some deficiencies in ITS are paragraphs of text extracted from assessment reports. Neither deficiency descriptions nor corrective actions identify any causes and preventive actions for repetitive deficiencies (e.g., fire extinguisher inspections not performed) or systemic deficiencies (e.g., training plans not up to date or workers not having training required by the IWSs).

The Discipline Action Plans developed by ES&H teams have no linkage to the site's issue and deficiency management system, and references to how to manage identified deficiencies are vague and inconsistent. Little formal trend analysis of safety issues is performed except for issues involving quantitative regulatory-driven data, such as radiation exposure and injuries and illnesses issues. LLNL is developing a new assurance procedure that is intended to address trending and causal analysis weaknesses identified above.

Finding #11. LLNL deficiency and issues management processes and performance are not fully effective in documenting ES&H program and performance deficiencies and ensuring that effective corrective and preventive actions are developed and tracked to completion.

Injury and Illness Investigation and Reporting. LLNL's recordable injury rate and their days away, restricted, transferred (DART) injury rate have been somewhat worse than average when compared to DOE complex rates. Although sitewide rates in 2004 are showing improved performance, current rates for Defense and Nuclear Technologies, Plant Engineering, and the Security Department still exceed DOE averages. The PAT Directorate has had an excellent record, with no injuries in the last year and only three first aid cases. The management of occupational injuries and illnesses is described in ES&H Manual Document 4.5, *Incidents–Notification, Analysis, and Reporting*, and Document 10.1, *Occupational Medical Program*.

Injury and illness programs are being assessed by the directorates as a focus area as designated by the LLNL ES&H Working Group. Each directorate has established some form of injury prevention program. In the past year, much effort has been directed across LLNL to address ergonomic issues and reduce repetitive motion injuries. Injuries and illness events are often the subject of department and directorate safety meetings.

This year, in part to address a declining safety record, Plant Engineering has been conducting a safety campaign involving six areas for improvement, including communications, behavior-based safety, supervisor/management involvement, enhanced work planning, creating a learning organization, and "wellness." Initiatives include expanding the behavior-based safety process; a "safety link" observation or concern form for all employees; a pre-task hazards analysis work sheet where workers document work steps, potential hazards, controls, and tools required each day/for each task; and a more formal process of evaluating near-miss (non-ORPS reportable) incidents and identifying preventive actions and lessons learned.

The Security Department hired an independent contractor to provide supervisor training on ergonomics under field conditions and developed and conducted a special ES&H training course for supervisors. The Security Department also has an established ES&H suggestion program and a program that awards gift certificates for individual safe work performance and safety improvement recommendations.

The management of injury and illness cases is a collaborative effort between individual supervisors and their directorates, the Health Services Department, and the Hazards Control Department. If an injury or illness occurs, supervisors are required to promptly complete a Supervisor's Accident Analysis Report that provides details of the incident causing the injury or illness, identifies personal protective equipment (PPE) worn, conditions and activities that contributed to the injury or illness, and the corrective actions taken and recommended. A Hazards Control Department safety engineer or industrial hygienist is assigned as an investigator for each case and completes the formal investigation report providing the information specified on DOE Form 5484.3, in accordance with DOE Manual 231.1-1A Chg 1, *Environment, Safety, and Health Reporting Manual*. Maintenance of Occupational Safety and Health Administration Form 300 Logs and the reporting of injury and illness data to the DOE Computerized Accident/Incident Reporting System (CAIRS) are performed by the Hazards Control Department. Cases with days away or restricted days are managed by the Hazards Control Department in coordination with Health Services and the individual directorates. A comprehensive database provides for collecting and processing injury and illness investigation and reporting data to the CAIRS. Guidance for use of this database and other program elements, including the Supervisor's Accident Analysis Reports, is available on the ES&H internal website. LLNL record-keeping personnel routinely self-assess the completeness and accuracy of data submitted to CAIRS. LLNL performs quarterly and yearly queries of CAIRS data to identify and follow up on any discrepancies between current injury/illness reports and what has been reported to CAIRS.

Notwithstanding the positive initiatives and the management attention being paid to reducing injuries and illnesses, some significant weaknesses were apparent in the investigation of and reactions to injuries and illnesses. Supervisor's Accident Analysis Reports were not completed by line work supervisors as required by the ES&H Manual for over 40 percent of the injury and illness case files reviewed by OA. On the submitted reports, many were not returned to the Hazards Control Department injury and illness program administrator in a timely manner. This delay not only affects the timeliness of the safety investigation but also may delay reporting of injuries and illnesses to CAIRS. Further, many of the completed reports contained insufficient information, such as not specifying any corrective/preventive actions or failing to identify whether PPE was required or was used by the injured worker. Even when line supervisor investigations reports were not submitted, the Hazard Control Department safety engineers or industrial hygienists conducted investigations of reported injuries and illnesses. However, these investigation reports were typically cursory and in many cases duplicated the inadequate information from the Supervisor's Accident Analysis Reports. In one case, the investigation report stated that no action had been taken, even though the Supervisor's Accident Analysis Report identified a number of actions taken, as well as other ongoing actions. Further, Hazards Control Department investigations were frequently not completed in a timely manner—sometimes months after they were assigned. Neither the Supervisor's Accident Analysis Reports nor the Hazards Control Department investigation reports addressed ISM and work control elements, such as whether the work was adequately defined or planned, whether the hazards were adequately identified in IWSs, or whether adequate controls were specified. In some cases it was not clear what PPE was specified or whether the worker was using the required PPE. In one case, instead of identifying a specified corrective action, the "corrective" action was "took worker to the clinic." There was no evidence that recommended actions were subjected to any further evaluation or whether other actions, if any, were taken.

An example that illustrates these weaknesses was an August 2004 incident where a materials management technician opened a lead-lined container to identify unknown legacy materials in Building 332 and experienced a puff of "white powder" in his eyes as he was re-closing the container. Other than eye irritation treated at the incident scene and at the medical clinic, there were no apparent long-term effects from this incident. However, the Supervisor's Accident Analysis Report and investigation reports indicated that a half-face respirator was worn, but did not describe the details of the work being performed, what might be in the container, whether gloves or safety glasses were required or worn, or any work control document or procedural information. The work control documents for this work do not adequately identify the controls for the airborne lead hazard. For instance, the lead hazard sections of the two applicable operational safety plans require workers to have taken lead awareness training and to wash hands and wear latex gloves, but does not address respiratory or eye protection. The Building 332 facility safety plan does not address lead as a work hazard. Information, such as whether proper work planning and respirator issuance forms were completed, was not included. No corrective actions were specified in the supervisor's report, nor was there any description of any radiological evaluations or determinations as to the identity of the "white powder" the worker was exposed to from a lead-lined container in a contamination area of Building 332. The recommended action by the Hazards Control Department was to "replace aging containers." The Health Services medical report also did not question or identify the substance to which the worker was exposed. OA interviews identified that the white powder was lead oxide from the uncoated lead liners and that industrial hygienists had taken some surface swipes that indicated lead levels above LLNL allowable limits, but no corrective actions were identified. Corrective and preventive actions for any future inspection work on this type of container (there are approximately 70 of these uncoated lead-lined cans in the building) and the need to identify hazard controls for the disposition of these containers were not documented.

Although the ES&H Manual provides a general description of the management of occupational injuries and illnesses, primarily a description of various roles and responsibilities, there are no procedures that clearly define the CAIRS reporting process performed by the Hazards Control Department. LLNL reports injury and illness performance of some of its subcontractors based on contract length and expected person hours, criteria negotiated with LSO. However, these criteria were not in accordance with the limitations provided in DOE Manual 231.1 and may have resulted in underreporting of subcontractor data to CAIRS. The list of contractors that must report data to the Hazards Control Department has not been updated since November 2000. The process for including reporting requirements in subcontracts and for obtaining and reporting subcontractor injury and illness data is not addressed in LLNL procedures. LLNL has not assessed the accuracy and adequacy of the subcontractors' injury and illness reporting.

Finding #12. Injury and illness investigations lack sufficient rigor to ensure that causes are identified and that appropriate, effective corrective and preventive actions are identified and implemented.

Lessons Learned. Much lessons-learned information is being communicated to managers and workers through a variety of formal and informal venues at LLNL. The lessons-learned program is described in the ES&H Manual. Lessons learned from external ORPS reports and the DOE list-server are being screened at the institutional level, and selected lessons learned are posted to the lessons-learned intranet website and distributed to managers and subscribers by the institutional coordinator. Organizations are generating and distributing internal lessons learned, and there is evidence that lessons learned are being disseminated, posted, and regularly shared in staff, technical committee, and safety meetings. The lessons-learned intranet website provides links to external and internal lessons-learned sources, and links to selected lessons in various functional areas. Many directorate, division, and department websites also contain references or links to lessons learned. Actions taken for lessons learned are required to be addressed in the directorates' annual performance reports and the LLNL Annual ES&H Assurance Report.

Notwithstanding the communication of lessons learned cited above, the unstructured process and inconsistent implementation are limiting the effectiveness of the lessons-learned program. DOE Office of Environment, Safety and Health special reports and reviews issued during the last two years that described adverse trends in safety performance, such as electrical safety and hoisting and rigging, have not been distributed for evaluation and application at LLNL. Further, there is insufficient documentation to provide assurance that available lessons learned are being consistently and adequately screened for applicability to LLNL and that appropriate actions are taken to prevent similar events at LLNL. The institutional procedure does not require documentation of the various steps for screening, evaluating, and applying lessons learned. Assessments, issuance, and discussions in performance reports related to lessons learned often address dissemination and posting of lessons learned, but do not require feedback on specific applicability reviews, determination of the adequacy of LLNL processes, conditions, and practices, or the implementation of corrective/preventive actions.

Also, with the exception of NMTP work permits, post-job and post-experiment reviews and feedback are not being used by to identify, document, and correct lessons learned from work activities. Although the Plant Engineering whiz tag and preventive maintenance forms contain blocks for documenting ES&H feedback, they are rarely used to document worker or supervisor feedback and lack formal documentation of evaluation or action when feedback is supplied. NMPT workers and supervisors have not consistently completed the ES&H feedback blocks on work permit forms. Although Plant Engineering conducts post-job analyses for some complex activities, this process is not defined in procedures and there are no formal mechanisms for worker feedback on maintenance job orders. The PAT Directorate does not conduct formal post-experiment reviews for research program activities.

Employee Concerns. Several formal and informal processes are available and advertised to workers to express and get resolution of employee safety concerns at LLNL, but workers seldom use the formal processes to report safety issues. Section 9 of the “Employee’s Guide” on the LLNL intranet website identifies the informal and formal mechanisms for resolving problems of any nature and provides links to web resources for these processes. The stated policy at LLNL is that workers should first address concerns to their supervisors or to line managers, or ES&H representatives, or subject matter experts whenever possible. Alternately, there is an ES&H hotline number published on the internal website and such other mechanisms as the Plant Engineering Safety Link program. The hotline receives between 40 and 50 calls each year, but they are primarily inquiries concerning who to contact for ES&H questions. A log is maintained documenting the questions or concerns and the referral to ES&H personnel. However, the actual disposition by the responsible party is not being documented, nor is there closure that the question or issue was adequately resolved.

The Employee Relations Office is identified as a source of both informal and formal vehicles to address employee concerns. A formal whistle-blower program administered by the Staff Relations group in the Employee Relations Office has been in place for about two years and has received three ES&H-related concerns in calendar year (CY) 2003 and CY 2004. An Investigations Working Group of LLNL managers, formerly called the Oversight Working Group, evaluates reported employee concerns and initiates and directs their management and disposition. The responsibility for investigation of these concerns is assigned by the working group to appropriate organizations, such as Audit and Oversight or the Price-Anderson Amendments Act Office.

However, several weaknesses were identified in the handling of these concerns. Although there are procedures that generally define the responsibilities for reporting and investigating whistle-blower concerns, there are no formal LLNL institutional or directorate procedures that detail the process for how employee concerns received in this program will be managed to resolution. The Investigations Working Group has no charter, and documentation is limited to a log of issues assigned, investigators, and open and closed dates. The resolution of a concern related to the improper reporting of injury and illness data received in March 2004 has not been timely. Although a limited evaluation was conducted at the direction of the working group, resulting in an unsigned and unapproved summary report, and the working group subsequently directed that a formal audit of the injury and illness reporting program be conducted, the audit has not yet been initiated. No formal case file has been established for this concern identifying essential information, such as the specific words of the allegation or the chronology of the investigation efforts and conclusions. No Staff Relations case file had been started for another concern, received in July 2004, which was forwarded to the Price-Anderson Amendments Act Office for investigation.

Other Feedback and Improvement Mechanisms. Safety committees in the Security Department and in Plant Engineering provide effective forums for communication of ES&H concerns and performance data between management, safety personnel, and workers. Plant Engineering has effectively employed a behavior-based safety observation program in several of its groups that provides real-time communication of unsafe behavior and identification and correction of safety issues based on analysis of observation data.

This program is being expanded to other Plant Engineering organizations as part of the ongoing safety campaign.

D.3 CONCLUSIONS

LSO is performing a number of line management oversight activities and is making progress on revising its procedures and processes to reflect the NNSA reengineering effort and line oversight/contractor assurance system (a DOE initiative to enhance feedback and improvements systems for DOE organizations and contractors). LSO recently completed an effective organizational self-assessment that identified a number of deficiencies that are consistent with the deficiencies identified on this OA inspection. Also, some LSO elements are performing effective line oversight activities that are contributing to improvements in ES&H performance at LLNL. In a number of cases, LSO assessments have been effective in identifying deficiencies in LLNL safety controls and have resulted in improvements in ES&H programs and performance (e.g., electrical safety during penetrations/excavations and unreviewed safety question determinations). However, many of the needed procedures and directives are not currently in place or are not fully and effectively implemented. In addition, some of the important mechanisms for assessing LLNL ES&H performance, including operational awareness activities, assessments, Facility Representative reviews, and issues management processes, are not consistently implemented or are not sufficiently rigorous.

Many mechanisms are being used to provide feedback and improvement in safety performance at LLNL. Line managers, ES&H personnel, and assurance managers all demonstrated involvement and commitment to improving safety performance and reducing injuries and operational incidents. Independent and management self-assessments are performed, deficiencies and issues are identified, corrective actions are developed and implemented, and lessons learned are frequently and widely disseminated. The new ITS tool for tracking ES&H deficiencies and issues provides much better flexibility and accessibility for monitoring performance and identifying trends.

However, inconsistencies and weaknesses in processes and in the implementation of feedback and improvement mechanisms have hindered their effectiveness in driving continuous improvement in ISMS implementation. Assessments are not sufficiently focused on work observation, operations, and implementation of ISM. ES&H issues are not effectively and consistently managed to ensure that corrective actions fully address program and performance deficiencies. Increased rigor is needed to ensure that lessons learned are consistently evaluated for applicability to LLNL activities and conditions and that corrective/preventive actions tailored to LLNL are identified and implemented where appropriate. Additional rigor in the investigation and development of preventive actions for injuries and illnesses is needed. Documentation of the management of employee concerns also lacked sufficient rigor. Most of these weaknesses were identified by the 2002 OA inspection but have not been fully or effectively addressed by LLNL management.

D.4 RATING

Core Function #5 – Feedback and Continuous Improvement…........................NEEDS IMPROVEMENT

D.5 OPPORTUNITIES FOR IMPROVEMENT

This OA inspection identified the following opportunities for improvement. These potential enhancements are not intended to be prescriptive. Rather, they are intended to be reviewed and evaluated by the responsible LSO and LLNL contractor line management and prioritized and modified as appropriate, in accordance with site-specific programmatic objectives.

LSO

1. **Develop a comprehensive plan and schedule for completing, fully implementing, and verifying the important elements of the LSO oversight program that are not currently fully functional or effective.** Specific actions to consider include:

    - Develop and implement a process for the generation of a master assessment schedule that captures and schedules self-assessments, periodic formal assessments, external reviews, and "for cause" reviews.

    - Implement, verify, and validate an ECP in accordance with DOE Order 442.1A, *DOE Employee Concerns Program*.

    - Implement, verify, and validate a lessons-learned program in accordance with the lessons-learned SOP.

    - Develop and implement a formal issues management and corrective action tracking program that supports the identification of ES&H trends across LSO and LLNL.

    - Update staff position descriptions and service-level agreements with the NNSA Service Center so that they reflect the current organization and current roles, responsibilities, and authorities.

    - Develop and implement a quality assurance plan in accordance with DOE Order 414.1B or any successor directive.

    - Establish a memorandum of understanding with EM in accordance with the DOE FRAM and the EM FRAM, and evaluate and update other interface description documents, as necessary.

    - Define and implement a document and records management program in accordance with the applicable requirements of United States Code Title 44, Chapter 31, *Records Management by Federal Agencies*, and DOE Order 414.1B and associated guidance.

    - Conduct a comprehensive review of the training program in accordance with DOE Order 360.1B, *Federal Employee Training*, and DOE Manual 426.1-1A.

    - Complete and implement the formal procedure for the conduct of the DOE/UC contract Appendix F review of contractor performance.

    - Ensure implementation of the LSO self-assessment program in accordance with the LSO Level 1 SOP.

    - Ensure that the responsibilities of the LSO program personnel and the LSO Assistant Managers and Team Leaders for operational awareness and FISHE documentation are clearly communicated, understood, and accepted.

- Conduct a comprehensive review of the Facility Representative Program in accordance with the LSO Facility Representative Program SOP.

2. **Enhance the technical rigor and quality of operational awareness activities, assessments, Facility Representative activities, and issues management for LLNL ES&H activities.** Specific actions to consider include:

   - Establish clear expectations and hold personnel accountable for implementing operational awareness activities as defined in OAIPs.

   - Determine functional area review periodicity (per DOE and LSO directives) as required by the LSO ES&H Assessments and Reviews SOP.

   - Consider assigning mentors to less experienced Facility Representatives and ES&H assessors to improve performance.

   - Conduct periodic reviews of performance to determine the effectiveness of improvement initiatives and identify additional needed improvements.

LLNL

1. **Strengthen the self-assessment program to ensure that the evaluations of all ES&H elements are being conducted as frequently and rigorously as necessary to effectively identify performance weaknesses and drive continuous improvement in the application of ISM.** Specific actions to consider include:

   - Improve the tailoring of self-assessment programs to address each directorate's specific activities, facilities, and conditions.

   - Focus assessment activities on operations, work observations, and the implementation of ISM.

   - Ensure that ES&H program and management system owners conduct regular assessments of the implementation of their programs from an LLNL-wide perspective.

   - Ensure that self-assessments are substantive and provide useful information on the level of performance to support improvement.

   - Strengthen the characterization of conclusions and findings identified in Assurance Review Office reports and assessments and ensure that site management formally evaluates and initiates appropriate actions to address the issues raised in these reports.

   - Strengthen the rigor, formality, and timeliness in the documentation of self-assessments, with special emphasis on the evaluations of ISM performance.

2. **Strengthen the management of ES&H deficiencies and issues.** Specific actions to consider include:

- Revise ES&H Manual Document 4.2 to clarify the use of ITS and address procedural weaknesses. Ensure that all deficiencies, regardless of the source, are entered into ITS for tracking and trending.

- Provide guidance and/or training on the expectations for identifying causes and establishing preventive actions.

- Relax the barriers to accessing ITS information and establish clear expectations that issue and deficiency data in ITS, including institutional matters, is to be released to the laboratory view to make data available for information and analysis.

- Prioritize the development of the assurance procedure that will establish processes for causal analysis and periodic trend analysis of ES&H deficiencies to identify adverse or improving trends or generic concerns to focus resources and inspection/assessment efforts.

- Provide formal mechanisms to document worker and supervisor feedback at the end of maintenance and programmatic work activities, including documented dispositions.

- Develop institutional procedures and requirements for investigating operational incidents that do not meet the threshold for reporting to ORPS.

3. **Strengthen injury and illness investigations to ensure that causes for each incident are identified and appropriate preventive actions are identified and implemented.** Specific actions to consider include:

    - Issue formal procedures or strengthen the relevant ES&H Manual sections to fully describe the investigation and reporting processes and requirements for injury and illnesses.

    - Establish oversight and controls to ensure that Supervisor's Accident Analysis Reports are completed by line supervisors and meet requirements for completeness and quality.

    - Establish oversight and controls to ensure that Hazards Control Department injury and illness investigations are rigorous, address work control elements, identify causes, and establish appropriate preventive actions.

    - Document deficiencies identified by injury and illness investigations and resulting corrective/preventive actions in ITS.

    - Establish formal criteria and procedures for subcontractor reporting of injury and illness data to LLNL that meet the reporting criteria in DOE Manual 231.1-1A Chg 1. Provide appropriate monitoring to verify the accuracy of the subcontractor-supplied data.

4. **Strengthen the lessons-learned program to ensure that appropriate lessons learned are consistently developed, screened, and applied to training and work activities at LLNL.** Specific actions to consider include:

    - Establish mechanisms to document and ensure that the screening of external lessons learned is consistently performed, subject matter expert evaluations are conducted, any required actions are tailored to LLNL processes, and required actions are verified to be implemented.

- Ensure that all institutional, division, department, and facility-level procedures and processes for training and work control planning specifically address the evaluation and application of lessons learned to LLNL activities.

5. **Increase rigor in the documentation and implementation of ECP elements by developing a formal process to better document concerns reported through the whistle-blower and ES&H hotline programs and the details of their resolution.** Specific actions to consider include:

   - Issue formal LLNL procedures detailing the process for managing ES&H-related employee concerns reported through the whistle-blower program, including a charter for the Investigations Working Group.

   - Ensure that evaluations are performed in a timely manner and rigorously documented, and ensure that the status of investigations is communicated to concerned individuals.

APPENDIX E

Essential System Functionality

E.1 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Independent Oversight and Performance Assurance (OA) evaluated essential safety systems at the Plutonium Building (Building 332) at Lawrence Livermore National Laboratory (LLNL). The purpose of an essential system functionality assessment is to evaluate the functionality and operability of selected systems and subsystems that are essential to safe operation. The review criteria are similar to the criteria for the Defense Nuclear Facilities Safety Board Recommendation 2000-2 implementation plan reviews; however, OA reviews also include an evaluation of selected portions of system design and operation.

This assessment addressed five safety systems at the Plutonium Building: the safety-class fire detection and suppression system and four safety-class ventilation systems: the Increment 1 room ventilation system; the Increment 3 room ventilation system; the glovebox exhaust system; and the final high efficiency particulate air (HEPA) filtration stages.

The OA team evaluated engineering design, configuration management/quality assurance, surveillance and testing, maintenance, and operation of the safety systems. The reviews included analysis of system calculations, drawings and specifications, vendor documents, facility-specific technical procedures, facility walkdowns, and interviews with system engineers, design engineers, maintenance and testing engineers, operators, technical managers, and other technical support personnel.

OA also reviewed the LLNL systems engineering program and the Livermore Site Office (LSO) safety system oversight program. These programs are being implemented in response to relatively new DOE requirements. Appendix D provides a broader discussion of LSO and LLNL feedback and improvement processes.

E.2 RESULTS

E.2.1 Engineering Design

The Plutonium Facility consists of several buildings that were constructed at different times over a period spanning five decades, with Increment 1 being completed in 1961 and Increment 3 in 1977. The designs of the ventilation and fire protection systems are described in the Building 332 safety analysis report (SAR), which identifies the safety functions of these systems and, in general terms, how they fulfill these functions. In addition, the SAR includes technical safety requirements (TSRs), which identify applicable operating limits intended to ensure that systems can perform their safety functions. The current SAR was approved by LSO in 2002.

The primary safety function of the ventilation system is to prevent the release of radioactive materials during normal conditions and accidents. It performs this function by maintaining contaminated areas at more negative pressures than adjacent less-contaminated or clean areas and directing building exhaust air through HEPA filters. For example, the gloveboxes are maintained at about -1.0 inch water column (w.c.), the work rooms at -0.2 inch w.c., and corridors at -0.15 inch (with a maximum of -.05 inch w.c.).

The ventilation system is designed to automatically handle system upsets (e.g., loss of a fan) and design basis accidents, such as seismic events and room fires.

The primary safety function of the fire suppression system is to protect the room ventilation system HEPA filters during a room fire by cooling the exhausted hot gases (with a deluge system in the exhaust ducts) before the gases reach the HEPAs. It also serves the safety-significant function of mitigating room fires by supplying room sprinklers.

The OA team determined that most of the safety functions and design criteria of the ventilation and fire suppression systems are appropriately defined in the SAR and that in most respects, the systems are appropriately designed to perform their safety functions under normal conditions, upsets, and most accident conditions. Furthermore, the systems have undergone important design improvements over the last several years. For example, the glovebox exhaust ductwork was redesigned to address cracking problems, some supply air dampers were added and others were modified to improve confinement during a loss-of-power event, and backup to the critical air supply was added to address a system vulnerability upon loss of air. In addition, the Nuclear Materials Technology Program (NMTP), the LLNL organization responsible for Building 332, has installed fire protection modifications to improve reliability, such as a new nitrogen source for the fire protection system emergency water supply and a new alarm and supervisory system. Several modifications are also identified in the SAR as being implemented to ensure the fire protection system's ability to function for the design basis seismic event. NMTP is also improving its documentation of the fire protection system's capability by preparing an extensive flow calculation, which will provide an important tool for understanding the system's design.

Although significant improvements have been made to the systems' designs, several remaining design analysis weaknesses raise concerns about whether they could adequately function for certain design basis accident conditions, such as severe seismic events or room fires. These include:

- **The potential for failure of the safety-class room exhaust HEPA filters due to combustion product loading during a design/evaluation basis fire has not been analyzed**. For a design basis room fire, combustion products could plug the safety-class exhaust HEPA filters and cause them to fail due to high differential pressure (dp). This condition has not been fully analyzed, and preliminary analyses performed by the OA team indicated that some current TSR-allowed and actual room combustible loadings may exceed the safe filter loading capability.

- **The Increment 3 room supply ventilation system's ability to adequately throttle flow in response to plugging of the exhaust system HEPA filters for a design basis room fire has never been verified by analysis or test.** The room supply system must throttle flow to prevent overpressure in Increment 3 because pressurization would invalidate the accident analyses by allowing an unfiltered, ground-level release. However, the supply fan vanes may not be able to throttle flow to the required extent because of their design. After the OA team identified this concern, NMTP performed a test that demonstrated the ability of the supply system to provide adequate throttling to maintain building pressure within TSR limits. Nevertheless, NMTP judged the margin of the throttling capability to be small enough to warrant considering changing the supply fan trip setpoint to a higher exhaust flow value.

- **The basis for the TSR limit of -0.05 inch w.c. dp between the building corridors and the outside has not been established.** This value is low and may not adequately account for dp reversals that could result from wind-induced negative pressures on the outside of the building or instrument uncertainties.

- **The safety-class water supply for the fire protection system is not provided to all safety-class deluge nozzles in room exhaust plenums in Increment 1 intended to protect the HEPA filters in a room fire.** The SAR provides a very clear description of this configuration, but does not provide justification for acceptability of this alignment. At the time of this OA inspection, LLNL had generated a draft analysis indicating that, for a design/evaluation-basis fire in Increment 1, the plenum air temperature will be less than 212 F. When this analysis is completed, it may provide a basis for resolving this issue.

- **There is no analysis of whether the fire suppression system can deliver the required flow to the HEPA filter deluge system. A preliminary fire protection calculation indicated that the system cannot deliver the 3 gallons per minute deluge (gpm) flow per HEPA filter as stated in the SAR.** The preliminary fire protection system flow calculation indicated that the 3 gpm requirement cannot be met when the street main is at the TSR minimum value of 58 pounds per square inch gage (psig). The LLNL staff stated that the preliminary results indicate flow rates on the order of 2.8 gpm and that 2 gpm is a minimum acceptable flow rate, based on application of requirements in the DOE fire protection standard (DOE STD 1066). Although the safety significance of this issue appears to be low, it has not been formally addressed, and the safety analysis is potentially inadequate.

Furthermore, the translation of some of the critical system design parameters into TSR requirements was either incorrect or incomplete. As examples:

- The TSRs identify 72 psig as the required overpressure in the fire water tanks rather than 75 psig, which was the National Fire Protection Association (NFPA)-based criterion that was used to size these tanks.

- The TSRs identify 400 psig as the minimum pressure requirement for the nitrogen backup tanks rather than 2,000 psig, which was used in the calculation of record for the original tanks (and is also the pressure currently maintained in the current tanks).

- The TSR administrative limits for the fire loading are not based on the HEPA filter loading but on the NFPA two-hour fire limit fuel loading. The potentially more limiting value based upon filter loading has not formally analyzed.

Finding #13. **NMTP has not adequately analyzed the design of the safety-class ventilation and fire protection systems and has not adequately translated some critical system parameters into technical safety requirements (TSRs).**

In addition to these design analysis weaknesses, the OA team's review identified two significant design deficiencies that could render the fire suppression system unable to deliver appropriate flow during a fire when normal fire water supplies are not available (such as during a seismic event).

One design deficiency, introduced into the system by a 1995 modification, is the inappropriate location of a pressure sensing line that could cause a control valve to cycle open and closed as the system piping where the sensor is located is alternatively pressurized and depressurized. This control valve is required to remain open during an accident where normal, non-safety-class fire water is lost. The same deficiency was present in the original design and was initially corrected by a modification in 1984, which appropriately relocated the pressure sensing line to upstream of a backflow preventer valve. Subsequent modification in 1995 relocated the sensing line back downstream of the backflow preventer valve, thereby reintroducing the problem.

Another design deficiency was introduced into the system during a 2004 modification to replace the existing backup nitrogen tanks for pressurizing the safety-class fire water storage tanks. Because this modification was not effectively controlled by the design control process, it did not meet the LLNL design, installation, and procurement requirements and introduced uncertainty about backup system operability (particularly during seismic events). Further, NMTP did not properly evaluate the functional and pressure boundary requirements for the backup nitrogen system. As a result, NMTP classified the system as defense-in-depth based on the SAR's lack of clarity on the nitrogen system classification, rather than on an engineering analysis of the function of the system during accidents and its relationship to other safety-class systems.

Finding #14. NMTP did not adequately evaluate and process system modifications, degrading a safety-class system to the extent that it might not be capable of performing its safety function under all design basis accidents conditions.

NMTP has taken appropriate actions to address most of these analysis and design issues in the short term by formally initiating their potentially inadequate safety analysis (PISA) process. In addition, NMTP has formally notified the National Nuclear Security Administration of most issues that were identified during this evaluation. These actions are appropriate to support timely and effective resolution of the issues and to support any interim actions needed to ensure the facility is operating safely. Given the number of issues identified in a short period, NMTP has, in most cases, properly judged their significance, assigned appropriate priorities, and gathered the required additional information needed to support issuing PISAs and/or make management notifications. Final analysis and closure of these issues remain to be processed in accordance with the LLNL unreviewed safety question (USQ) procedure.

Although most issues were appropriately addressed in accordance with the PISA process, three were not. First, the fire suppression system nitrogen modification did not consider the impact of the change on the safety-class pressure boundary for the fire water tanks and introduced a discrepant condition. Second, the 400 psig pressure limit in the nitrogen tanks, provided in the TSR and SAR, is contrary to the requirements provided in the calculation of record. Finally, the safety-class function of the pressure control valves has not been tested since they were installed. LLNL has incorrectly decided not to process these concerns in accordance with the PISA process.

Finding #15. NMTP has not adequately implemented the LLNL potentially inadequate safety analysis (PISA) process to address some Building 332 design and safety analysis deficiencies.

Summary. The safety-class ventilation and fire suppression systems reviewed are, in general, adequately designed to perform their safety functions during normal operations, system upsets, and some accident conditions. However, significant deficiencies were noted in some analyses needed to ensure that the systems will perform adequately during design basis accident conditions. In addition, two deficiencies in the current design of the fire protection system could render the system inoperable during certain events, such as design basis seismic events. Furthermore, significant deficiencies in the SAR and TSRs have resulted from improper translation of important parameters supporting system function.

E.2.2 Configuration Management/Quality Assurance

Configuration Management. The purpose of the configuration management program is to ensure that the design remains adequate and within the requirements of the SAR. The Building 332 TSRs specifically require that a configuration management program be established, implemented, and maintained to control the facility configuration and to identify and document the technical baseline of facility structures, systems, and components. Key elements of the program specified in the TSRs are: (1) documentation that identifies the technical baseline for facility structures, systems, and components; (2) a process for developing, assessing, approving, issuing, and implementing changes to the technical baseline; (3) a process for recording, controlling, and indicating the current status of technical baseline documentation; and (4) control of the installation and removal of temporary modifications. Further requirements for configuration management are included in the LLNL Environment, Safety, and Health (ES&H) manual and the Defense and Nuclear Technologies (DNT) Directorate configuration management program, including specific requirements for identification and control of configuration items.

NMTP has established some elements of configuration management. For example, they have developed a work control/design change process document that discusses maintenance of the technical baseline. However, OA identified two major areas of concern. First, longstanding configuration management deficiencies have not been addressed. These deficiencies prevent NMTP from fully meeting Building 332 TSR configuration management requirements and adversely impact the ability to operate the facility in a safe and efficient manner. The resulting weaknesses include: (1) an incomplete set of facility baseline technical documents (e.g., vendor documents are missing), (2) no system diagrams (e.g., piping and instrument drawings) that indicate boundaries and interfaces with other systems (except for the emergency power system), and (3) no detailed system design descriptions for safety-class systems (except for the emergency power system). These weaknesses are due, in part, to the less-stringent configuration management requirements in place at the time of the original design and construction of the facility. In addition, because Building 332 was at one time slated to be shut down in 2000, resources to improve configuration management were not considered to be cost beneficial in the late 1990s. However, the current operational lifetime is estimated to be in the order of 15 years, and correction of longstanding configuration management weaknesses is warranted.

The lack of an effective configuration management program has diminished NMTP's ability to maintain reliable safety systems at Building 332. For example, a recent modification to the nitrogen skid, which supports safety-class functions, was identified and designed as a defense-in-depth system rather than safety-significant or safety-class, without an adequate basis for making this determination. Also, as discussed previously, a design change performed in 1995 reintroduced a design deficiency that was corrected in 1984. The absence of a system design basis and well-maintained modification records is a likely contributor to this error.

NMTP recognizes the extent of configuration management program deficiencies and has performed the gap analysis to support corrective actions (particularly, reconstitution of legacy deficiencies, such as lack of controlled as-built engineering drawings). However, NMTP and LSO have not taken timely and appropriate action to address the deficiencies, given their significance.

Finding #16. NMTP has not resolved longstanding and significant configuration management deficiencies that prevent NMTP from fully meeting all TSR-required configuration management elements. LSO has not ensured that appropriate actions are taken to resolve these configuration management deficiencies.

The second major area of concern is that NMTP has not adequately defined its configuration management program. Although NMTP issued a configuration management program plan in 1999, it has not been maintained or effectively implemented and, as a result, does not meet the TSR requirements. In addition, the 1999 program does not meet higher-level requirements established in the DNT and ESH configuration management plans. Further, the configuration management requirements in the DNT plan and TSRs have not been appropriately flowed down and integrated.

Specific elements of the DNT configuration management program that have not been established at Building 332 include:

- Identification of configuration items beyond the list of systems designated as important-to-safety

- Identification of configuration item owners (the system engineer was not aware of the configuration item concept)

- Identification of the full design document set, and conduct of a review to validate and document the set of design requirements to be maintained for each configuration item

- Document control, including a list of the required documents.

Specific elements of the configuration management program required by the TSRs that have not been implemented are:

- Documentation that identifies the technical baseline for facility structures, systems, and components

- A process for recording, controlling, and indicating the current status of technical baseline documentation.

The current LLNL and DNT configuration management programs address existing legacy configuration management weaknesses by incorporating a "go forward" approach for performing day-to-day activities. However, OA identified concerns with the "go forward" plan delineated in the DNT configuration management plan. Specifically, it explicitly limits the scope of the reconstitution to the portion of a configuration item "that is undergoing system upgrade, except where significant safety issues are determined to exist." The DNT configuration management plan further limits the scope of the reconstitution with the statement, "An upgrade to a portion of the configuration item does not require reconstitution and/or upgrade to the entire system." Although the ES&H Manual description for the configuration management program requires the directorates to implement the go-forward approach without any specific guidance on limits and requirements, this manual provides a very clear requirement on the scope of the change evaluation: "At the heart of an effective configuration management program is the currency and accuracy of the physical configuration of relied upon systems, structures, and components and the safety basis documents. It is critical that the configuration item owner identify all connected or impacted systems when evaluating a change. Changes to a configuration item design or operation may require changes to other safety envelope documents, e.g., facility safety basis documents, site safety documents, emergency preparedness and response documents, facility safety plans, and operational safety plans." The limits established in the DNT go-forward strategy could limit the scope of the review and explicitly limit the documentation of this review, thus further decreasing the documents' ability to reflect the as-built configuration accurately.

Significant weaknesses were also identified in application of configuration management to the ongoing day-to-day operation of the Building 332 facility. Examples include:

- **Improper processing of design modifications.** The work control process for design modifications is generally well defined and includes expectations for the composition and quality of work packages.

The highest level of control is applied for design modifications. However, implementation of this process was deficient, especially with the quality of the completed work packages. Details of concerns are discussed in Section E.2.4. These design work package deficiencies reflect poor configuration management and a failure to follow procedures rigorously.

- **Poor maintenance of the master equipment list.** The currently approved master equipment list is shown in Appendix A of the Maintenance and Operations Manual, dated October 1999. The master equipment list is significantly out of date and does not reflect many of the modifications to safety systems that have been implemented since 1999. For example, the downdraft air system is listed in the master equipment list as safety-significant, but the system is no longer in service. Other supporting information is also outdated, including the description of components (nameplate information), maintenance ownership, procedures, and maintenance/testing frequency. NMTP recognizes that the master equipment list is deficient and has initiated efforts to update it. It is important that the master equipment list be maintained, because it is one of the foundation elements of configuration management and it supports important activities, such as equipment procurement and designation of the quality level requirements for maintenance and modification activities.

- **Design records cannot be readily retrieved.** NMTP has not established a formal system for record retention that provides adequate assurance that design records can be located to support design modifications and maintenance and operation of safety systems. During this evaluation, the OA team requested records on design modification that had been performed on the ventilation and fire protection systems and found that there is no comprehensive modification list that allows document retrieval on a system basis. The record retention procedure is over nine years old and is not being utilized.

- **The USQ process is not being rigorously implemented.** As discussed in Appendix F of this OA report, the USQ procedure does not fully meet 10 CFR 830 requirements and has not been rigorously implemented to ensure that all system and procedure modifications are evaluated to prevent adverse impacts on the safety basis.

Finding #17. NMTP has not adequately defined and implemented its current configuration management processes to ensure maintenance of safety system configuration and functionality during day-to-day work activities.

Quality Assurance. Quality assurance (QA) and configuration management programs are closely linked at Building 332. The Building 332 SAR requires that a QA program be established, implemented, and maintained to ensure that the design, construction, modification, configuration, and operation of safety-related components meet applicable DOE and LLNL engineering and safety standards. The OA team reviewed selected aspects of the Building 332 QA program, including flowdown of QA requirements to implementing procedures and implementation of certain program requirements. Particular emphasis was placed on design control and procurement processes.

The Building 332 QA program is governed by the NMTP QA program document, which describes how the requirements in 10 CFR 830, DOE Order 414, *Quality Assurance*, the NDT QA plan, and LLNL ES&H Manual are implemented. The NMTP QA program document also describes, in general terms, plans and procedures for conducting QA activities in Building 332. Although the NMTP document provides some general information useful in outlining the QA program, it does not provide enough specific information to define the program, nor does it refer to all of the procedures that include these specifics. Examples include:

- **The specific duties of the QA engineer and inspector described in the work control procedure are not described in the QA plan or a QA implementing procedure.** Although the QA plan references the work control procedure, neither the plan nor a QA implementing procedure includes specifics for conducting activities, such as monitoring the QA aspects of work performed in the facility, serving as the Facility Engineering Design Review Committee chairperson, and reviewing work packages to assure completion and accuracy.

- **Flowdown of QA program requirements to implementing procedures is incomplete, and many implementing procedures are out of date and no longer accurately reflect all QA processes.** The NMTP QA plan does not identify an implementing procedure for Criterion 8, "Inspection and Acceptance Testing," other than an instrument calibration procedure. An inspection and testing implementing procedure exists, but is eight years old, does not reflect some current practices, and is not referenced in the QA plan. The procurement implementation procedure also does not reflect current practices and is nine years old.

- **The NMTP design change process does not ensure that the QA review of the completed design package is performed by an individual not involved in identifying the required elements of the design package.** The work control process manual discusses QA engineer review of design work packages, including completion of documentation, review of test results, and ensuring full implementation of the change control process. However, the QA engineer also has responsibilities in identifying required elements of the work package; consequently, contrary to the work control process manual, he/she cannot serve as an independent reviewer of the completeness of the document. In some instances the formal engineering design review may fulfill part of the independent validation requirement, but this process is not well defined.

In addition to weaknesses in program definition, the OA team identified two examples of lack of rigor in implementing QA responsibilities:

- **Failure to formally document the required engineering design review in three design packages.** These are: WR-03-25, Replace increment 1 exhaust damper solenoid; WR-03-30, Install new Underwriters Laboratory rated smoke damper in supply air duct to Increment 1; and WR-03-43, change supply damper function to fail close from fail open.

- **Failure to ensure that work packages are appropriately closed out.** The work control process manual requires that all design change documentation be included in closed work packages, including test, inspection, and procurement records. The QA engineer is responsible for ensuring that this documentation is included before closing out the work package. As discussed under Section E.2.4, however, several work packages were closed out without this required documentation or with incomplete documentation (e.g., missing signatures).

Finding #18. NMTP has not effectively defined its quality assurance (QA) organization and responsibilities in its QA program, has not maintained its QA procedures, and has not effectively implemented all of its QA functions.

Another important aspect of configuration management and QA for safety systems is the procurement process, which should ensure that equipment used for safety systems have the appropriate quality (e.g., materials, manufacturing and testing) for the safety functions they serve. LLNL uses the term "quality significant item" to identify the purchase of material for safety systems. The LLNL procurement process for quality-significant items is shared among the institutional level (Procurement and Material Department), the division level (e.g., DNT), and the program level (e.g., NMTP).

The Program and Material Department had made some improvements in the procurement of safety-related equipment. For example, an interim instruction, *Procurement Quality Assurance Requirements,* dated March 12, 2003 was issued, which adequately defines the responsibilities between procurement and the requester. According to this instruction, NMTP is responsible for specifying QA requirements for quality-significant items, and when items are purchased as commercial-grade, a completion of dedication plan is required to verify that the item meets the requirements for its intended use. Furthermore, NMTP has appropriately defined some of its QA procurement requirements in procedure NMTP-FMP-0200 Rev 0.0, *Like-in-Kind Determination for NMTP Facilities Replacement/Spare Items, Including Requirements for Procurement and Acceptance*, which was issued in September 2004, and in QIP-7, *Procurement Control Procedure,* issued in May 1995; NMTP is also in the process of revising the NMTP quality-significant item procurement procedure. In addition, NMTP has an effective program for preventing introduction of suspect and counterfeit items, which is well defined in a NMTP Suspect/Counterfeit Item procedure. Several suspect and counterfeit items have been discovered over the last couple of years, and have been appropriately documented and resolved utilizing the NMTP procedure.

However, there are significant deficiencies in the content and implementation of NMTP procurement procedures. For example:

- **The scope of the "like-in-kind" procurement procedure is too narrow to cover all of the procurement requirements in the LLNL interim procurement procedure.** The like-in-kind procedure does not include a general dedication process and forms that would cover procurement of quality-significant spare and/or consumable items. Also, the procedure does not include the inspection process and forms for material received from a qualified supplier.

- **The general NTMP procurement procedure, QIP-7, does not reflect the current LLNL procurement process.** For example, the procedure does not include the LLNL institutional definition of quality-significant items as the scope of items falling under this procedure. It also requires that a level of inspection will be selected from four levels and identified in the procurement package. This process is not being used. Furthermore, the QIP does not define a general dedication process/forms and an inspection process/forms for material received from a qualified supplier.

- **The procurement documentation for several recently purchased safety-class components is deficient.** Deficiencies include:

  - Like-in-kind procurement documentation for room ventilation supply damper actuators purchased in 2003 lacks individual signoffs confirming that the inspection criteria were satisfied for each actuator. The inspection signoff date indicates that the like-in-kind inspection sheet was signed off several months after the actuators were installed.

  - The like-in-kind documentation for the purchase of the solenoid installed to control the Increment 1 exhaust damper is incomplete. The acceptance sheet was unsigned. The solenoid has been installed for over a year.

  - The motor for exhaust fan FHE 1000 was replaced early in 2004. No quality-significant procurement dedication documentation was found for the installed spare motor. An offsite vendor performed reliability tests, but the tests were not part of a formal dedication process and were not documented.

- No quality-significant procurement dedication documentation was found for the current spare motor for the safety-class exhaust fans FHE 1000 and FHE 2000 to show dedication of commercial grade material for safety-related use. This motor was purchased within the last year; it is stored next to the operating motors and is available for immediate installation.

- No like-in-kind documentation or other quality-significant dedication procurement documentation was found for three spare motors for the glovebox exhaust fans to show dedication of commercial grade material for safety-related use.

- No like-in-kind procurement documentation or quality-significant procurement dedication documentation was available for the purchase of belts to be used in safety-related systems. The spare belts for FHE 1000/FHE 2000 are not marked as quality-significant and have been stored unprotected in the plenum exhaust building close to the operation motors. Shortly before this review, the belts were moved to a more appropriate storage cabinet.

Finding #19. NMTP has not established a procurement process for safety-class components that fully meets 10 CFR 830 and DOE Order 414.1A requirements and is not rigorously implementing its current procurement process.

Summary. The NMTP configuration management program for Building 332 has not been adequately defined and is not being implemented to ensure the functionality of safety-class components. Further, the QA program has significant weaknesses, both in program definition and, more importantly, in program implementation. These two fundamental and interrelated programs have not been adequately developed and implemented. Although configuration management problems have been recognized by both LLNL and LSO, appropriate action has not been taken to address them. Further, although some QA problems have been identified by LLNL, the full extent of QA problems has not been recognized and timely action has not been taken to address them.

E.2.3 Surveillance and Testing

Surveillances and tests are required to be defined in the TSRs to ensure that safety systems, structures, and components and their support systems required for safe operation are maintained, the facility is operated within safety limits, and that limiting control settings and limiting conditions for operations are met. For the safety systems reviewed, the OA team determined that most components were identified in the TSRs and that most TSR surveillance procedures were appropriate and were satisfactorily completed. NMTP has established some good tools and practices supporting its surveillance and testing program, including: (1) a procedure that defines the basic format of a surveillance procedure, (2) a procedure that describes the requirements for implementing a surveillance (which includes mandatory compliance with procedure steps), and (3) a program for ensuring that gauges used in support of the surveillance procedures are calibrated. In addition, NMTP closely tracks the due dates of surveillances by several methods, including the operations center status board, a monthly QA status report, and a Building 332 activity calendar.

However, two significant deficiencies were identified in the surveillance and test program:

- **Several important components requiring testing are not included in the TSRs.** For example, all check valves for the fire protection system located inside Building 332 and certain pressure control valves (i.e., PC-276, PC-279, PCV-277, and PCV-278) are not being tested. Furthermore, the pressure boundary valves for the fire protection system and the system supports do not receive periodic surveillance. There is no documented basis for excluding these components from testing.

- **One surveillance procedure does not appropriately test the TSR requirement.** SR 4.3.1.2, *Room Filter Bypass Dampers*, requires the bypass dampers to open if the flow drops below 50 percent of normal air flow conditions; however, the surveillance procedure tests only if the dampers go open when the flow is reduced (by covering duct entrances) but does not measure the flow rate at which the dampers open.

In addition, a concern was identified with the documentation of a surveillance. Specifically, the folder holding the records of SR 4.3.4, *Triennial Test of the Fusible Link Fire Damper*, shows that the surveillance was last performed in 2001. The file also includes a memorandum stating that two fire dampers were added in Room 1377 in 2003 and were tested in accordance with SR 4.3.4. However, the record of the test results could not be found, and the surveillance procedure was not revised to include these new dampers.

Finding #20. NMTP TSRs for Building 332 have not included or tested some important safety-class components, and one Building 332 TSR surveillance procedure did not adequately demonstrate full compliance with its associated TSR requirements.

Several other weaknesses were identified in surveillance procedures. As examples:

- The surveillance procedure for the fire system control valves includes poor instructions and data sheets that raise concerns on control of system restoration.

- A few surveillance procedures do not have the correct revision identification throughout the procedure. The SRP-B332-019 cover sheet identifies the revision as 3; page 2 of 3 identifies the revision as 2. This error also occurs in SRP-B332-020, SRP-B332-021, and SRP-B332-024.

- Some steps in some surveillance procedures are not clear. For example, SRP-B332-018 does not require the as-found condition to be recorded as part of flow switches data collection (if the as-found condition is not within specifications, the procedure allows adjustments to be made and the new results are recorded). Also, although one step of the SRP-B332-018 procedure directs the performer to verify that valves listed on the datasheet are secured in their normal operating position and to record that information on the datasheet, the datasheet does not have this data element and the results are not being recorded.

Summary. Although most of the important safety-related components for the fire protection and ventilation systems have TSR requirements and are being appropriated tested, the TSRs are not complete, and some surveillances and tests are not adequately implemented. Several important safety-related components are not identified in the TSRs, one parameter identified in the SAR is not being appropriately addressed in surveillance tests, and some TSR surveillance procedures have not been appropriately implemented. These surveillance and test requirements are particularly important in ensuring continued functionality of the safety-class system.

E.2.4 Maintenance Program

The Building 332 maintenance program has been established using DOE Order 4330.4B, *Maintenance Management Program*, as a guide. The maintenance program is defined in the ES&H Manual, Document 52.1, *LLNL Maintenance Implementation Plan for Nonreactor Nuclear Facilities*. Specific requirements for Building 332 are found in Appendix B of Document 52.1. Other key documents defining the maintenance program include the *Plutonium Facility – Building 332 Work Control/Design Change Control Process Manual*, the *Plutonium Facility – Building 332 Maintenance and Operations Manual*, and a memorandum of understanding between NMTP and Plant Engineering. The combination of these documents lays out an adequate framework for the maintenance program. The OA team reviewed several aspects of the Building 332 maintenance program, including preventive, corrective, predictive, and lifecycle maintenance, as well as work control processes and material condition.

The OA team determined that preventive maintenance is being adequately scheduled, tracked, and performed by Plant Engineering. The preventive maintenance program is generally well defined. LLNL uses standard preventive maintenance for the fans and motors throughout the Laboratory. The scope of this standard preventive maintenance appears adequate for the fans and motors in Building 332. Plant Engineering is current with the performance of this year's required preventive maintenance. However, a few special tasks are occasionally performed with the motors and fans at Building 332 that are not reflected in the task code (preventive maintenance procedure). For example, when a belt is replaced on a fan at Building 332, it has been informally required that a belt tensioner gauge and a laser alignment tool be used. Results of using the belt tensioner tool are recorded on a form in the Operations Center. This informal guidance has not been formally documented in the associated task codes or preventive maintenance procedures.

Corrective maintenance is also being identified and completed in a timely manner, and as a result, there is no maintenance backlog for safety-related systems. A recent listing of the outstanding "whiz" tags (corrective maintenance) shows that safety-related tasks are not overdue. Predictive maintenance activities, such as vibration testing, lube oil and fuel oil sampling, and electrical panel hot spot inspections, are being performed. Routine infrared readings are taken and recorded on the safety-related electrical panels in Building 332, and based on these results, corrective maintenance has been performed (e.g., tightening connectors). NMTP routinely takes lube oil and fuel oil samples, and the sampling results indicate that the oils are satisfactory. Overall, the vibration program is adequate and has resulted in identifying maintenance needed on fans/motors in Building 332 before failure. For example, based on vibration results, motor replacement was recommended and replacement was conducted on supply fan ACU-3 in 2003. A technician is engaged when new equipment is installed, vibration monitor points are added, and the reading points are added to the vibration recording equipment.

To support equipment lifecycle maintenance, LLNL annually performs condition assessment surveys. These surveys are being satisfactorily performed at Building 332 and have validated a list of equipment to be replaced in the next three to five years as deferred maintenance. The condition assessment survey starts with the development of inspection sheets from the Asset Master Equipment List. Inspection areas consist of mechanical, electrical, architectural, and asbestos material condition. The inspector evaluates the condition of the equipment, repair actions needed, and the urgency to repair/replace the equipment. The optimum replacement year is determined and shown on the inspection form. The last inspection at Building 332 was completed in March 2004. Based on the inspection results, the deferred maintenance lists (mechanical and electrical) were updated.

Some weaknesses were identified in the maintenance program: (1) as discussed previously, a few preventive maintenance tasks are not documented, (2) the predictive maintenance program has not been formally defined in a program document, (3) no diesel generator oil sampling results have been recorded since July 2002 even though samples have been taken, and (4) tracking and trending of maintenance information is not being performed for Building 332 equipment. Systems engineers are assigned this task but have not had the resources to collect and analyze the maintenance data. The plant engineering database for whiz tags is an adequate resource for material history, but information from the database is not being utilized. Furthermore, the condition assessment survey process is described in the Plant Engineering maintenance and operations procedure, but a detailed description of the process has not been documented in a maintenance procedure, and detailed inspection checklists have not been developed in some cases. LLNL has initiated efforts to develop procedures and inspection checklists.

OA also evaluated the work control process for facility modifications and other maintenance activities to determine whether the process is adequately defined and implemented. NMTP has established a rigorous work control process for design change and maintenance activities. The process is clearly defined and includes an appropriate description of how to use the Plutonium Facility Work Permit and NMTP Work/Change Request-Form A, and the expectations for the composition and quality of work packages. However, OA's reviews of several design changes and a recent maintenance package for replacement of exhaust fan FHE 1000 identified several concerns with the rigor of implementing the process, especially with the quality of the completed work packages. Several of the work packages that OA reviewed had missing or incomplete required documents, including acceptance criteria, bills of material for safety-related material, and post-maintenance testing documents. Specifically:

- **Work Package WR 03-25 (Replace Increment 1 Exhaust damper solenoid).** Deficiencies included: no acceptance criteria defined in the work permit, unsigned acceptance sheet, and inadequate post-maintenance testing documentation for the performed retest (procedure used and test results not in work package). Furthermore, the engineering design review process results were not formally documented, contrary to the work control/change procedure requirements.

- **Work Package WR 03-43 (Replace increment 1 Room supply motor damper actuator).** The following step is included and appears to be an acceptance criterion, but is not marked as such: "When complete, close isolation switch & verify damper opens." No records in the package indicate that this test was performed on each damper. Post-maintenance testing was to perform SRP 4.8.2 for one smoke detector in each room. The test procedure was not included in the package, and the specific steps used in the surveillance were not defined (although a datasheet of the results was located). The engineering design review process results were not formally documented, contrary to the work control/change procedure requirements.

- **Work Package WR 03-30 (Install Damper ACU3).** No acceptance criteria were defined or tested, and the post-maintenance test was defined as "test system after completion of modification" without any additional criteria or an approved procedure.

- **Work Package WR 02-15 (Nitrogen Back-up Air Tank Relocation Project).** There is no documentation in the work package indicating that appropriate post-maintenance tests were completed. Furthermore, no procurement documentation is available to ensure that material used in a safety-related system is appropriately certified.

These work package deficiencies reflect poor work control and a failure to rigorously follow procedures, and are additional examples of poor configuration management. These weaknesses also indicate that QA engineers did not ensure that the completed work packages were adequate, as required.

Finding #21. NMTP has not adequately implemented the current work control processes described in its Work Control/Design Change Control Process Manual.

The OA team also conducted system walkdowns to ascertain the physical condition of the system and identify any gross material degradation. Although no significant material degradation was identified during walkdowns, poor housekeeping was identified as a concern. Most of the areas contain what appears to be long-term clutter consisting of spare parts, used parts, miscellaneous other stored materials, tools, cleaning supplies, etc., and much of the operating equipment is dirty (e.g., buildup of excess grease, fan belt dust, and spilled oil). Facility personnel indicated that a lack of warehouse and storage space in the Superblock contributes to this situation.

Summary. NMTP has established effective programs for maintaining safety systems, including preventive, predictive, and corrective maintenance programs. In addition, LLNL has established an effective program for assessing remaining life of system components and establishing an appropriate replacement schedule. Weaknesses were identified in some of the programs, including lack of rigorous definition of predictive maintenance, failure to perform some appropriate tasks such as equipment trending and oil sampling, and failure to rigorously implement some aspects of the work control process. Although these weaknesses negatively impact some aspects of the maintenance program, in most respects LLNL is appropriately maintaining the safety system components to ensure their functionality.

E.2.5 Operations

The OA team evaluated operating procedures and operator training for the selected safety systems, as well as the knowledge and capability of operators to operate the systems under normal conditions and to take appropriate actions in the case of abnormal and accident conditions.

Operating Procedures. NMTP has established a set of operating procedures (facility operating procedures, abnormal procedures, and administrative control procedures) that, in general, effectively supports operations of the ventilation and fire protection systems. The facility operating procedures are the primary procedures utilized for equipment operation and they contain, in addition to operating instructions, information on the design, operation, and maintenance of the system. Some of the information is very useful to operators, such as detailed pre-operation checklist, system startup instructions, and instructions for changes in configuration of equipment (e.g., changing the lead/lag fan arrangement).

While these procedures provide some good information, they are not complete and in many cases are out of date. For example, there is no overall procedure that addresses the conduct of operations in the control room and specifically identifies duties of facility operators both while on site and on call. Some roles and responsibilities are defined in the facility safety plan, and additional information is provided in the maintenance and operations manual. However, neither the plan nor the manual provides details (or references appropriate procedures that contain details) on performing such duties as responding to alarms, operating equipment during emergencies, log keeping, verbatim following of procedures, and notifications. Further, alarm response (or annunciator) procedures have not been developed for the annunciators on the Panalarm panels, and there are only three abnormal operating procedures, none of which addresses response to fire in the radioactive materials area (RMA). In addition, although some useful information has been assembled about conditions that will cause alarms and control panel illuminations, this information is not complete. For example, the inputs that would cause the fan trouble lights to illuminate are not identified in the facility operating procedures.

Procedures also have not been well maintained and do not reflect some changes in the systems. For example, the addition of backup air supplies to ventilation system control dampers is not addressed in the facility operating procedures. Most of the facility operating procedures were last revised in 1997 and contain numerous informal pen and ink changes. These procedures are to be reviewed by the facility engineer or designated alternate every three years, but this review is not being performed.

Finding #22. NMTP has not adequately established and maintained operating procedures as required by the Building 332 TSRs.

Other identified procedure weaknesses include:

- No prerequisites, precautions, or limitations in the procedures. For example, there are no requirements specifying the operation mode for performing fan switching operations.

- No procedure guiding development of facility operations procedures.

- No step to warn personnel of the startup of a fan system (fan startup could cause a large differential pressure across doors when an exhaust fan is running and the supply fans are off).

Operator Training and Qualification. The facility SAR identifies operator training program requirements for meeting DOE Order 5480.20A. Details of the training program are contained in a Building 332 training plan. LLNL appropriately performed a job-task analysis to support the identification of training requirements. This analysis was generally adequate and identified the tasks that operators are responsible for, and therefore need training on. Some of the training material is well defined, performance-based, and appropriate, particularly the training on TSR surveillances. Furthermore, the LLNL training and qualification process includes oral boards and written exams. However, the OA team identified some important weaknesses in the training program. As examples:

- There is no specific criterion for training personnel on design changes or procedure changes. As a result, when a major change to the critical air system controlling the ventilation system was installed, no requirement was specified for operator training, and none was performed.

- Most training involves operators training each other and is largely limited to performing surveillances.

- There is a lack of training on some details of system operations. The only system operations training consists of reading the facility operating procedures. LLNL does not use available resources, such as system engineers, to provide details of system operation to improve operators' capabilities.

Controls/Indications. Building 332 has a centralized control room where controls and indications for operating the ventilation and fire protection systems are located. The controls are generally appropriate for operating these systems and indicating trouble conditions. An alarm panel provides annunciation for important system parameters, including corridor and room low differential pressure. Furthermore, NMTP recently upgraded its fire alarm panel.

Although most of the controls and indications are appropriate to support system operation, several control room indications are poorly labeled and/or do not reflect good human factor design principles:

- Exhaust fan flow indication does not indicate flow directly (it is square root indication), and there is no operator aid supporting conversion of the indication to flow rate in cubic feet per minute.

- Not all lights indicating power available work the same (i.e., some turn off when fans are running, while others stay lit).

- A “10 sec” label on one controller does not indicate the function of the controller.

- Several indicating lights have no labels below them (e.g., some indicators for trouble and open/close status are not labeled).

Furthermore, numerous informal operator aids in the control room and in the plant have not been processed in accordance with the operator aids procedure. Examples include:

- Adhesive notes stuck under the alarm panel (attached in December 2003) instructing operators not to respond to certain alarms

- Another adhesive note (also attached in December 2003) stating that PDIC 1050 Increment 3 damper is set at “manual 10%” and instructing operators to “Do not touch”

- Instruction sheet on “relocation of Inc 1 GBE west header pressure tap.”

Operator Knowledge, Performance, and Staffing. The purpose of operations procedures, training, and system controls is to provide the tools and knowledge for operation of the safety systems. The three senior facility operators for Building 332 demonstrated good knowledge of many aspects of the operation of the ventilation and fire protection systems, including normal lineups, procedures for swapping fans, TSRs, and most setpoints for automatic actions. During facility walkdowns, the operators demonstrated good understanding of local operation of equipment. Furthermore, the operators demonstrated a sense of ownership of the systems and recognized the importance of their proper operation and the need for daily monitoring of their performance via in-plant observations.

However, some specific weaknesses were identified in some system component operations during interviews and walkdowns:

- Operators do not have a good understanding of how a square root controller readout relates to actual flow for the Increment 1 exhaust fan other than at the operation flow setpoint value.

- Operators do not understand what the “10 sec delay” indication means on the control panel for the Increment 1 exhaust fans.

- Operators do not have complete understanding of how the reset button on some fans works.

- Operators do not have detailed knowledge of the operation of the backup to the critical air supply for the dampers (a system that was recently installed) and could not locate an abnormal operating procedure that had been developed for loss of critical air.

These weaknesses can be attributed to shortcomings in system design training.

The OA team evaluated operator performance during a walkthrough of some system operations. Although the ventilation systems are normally in steady state operation and fire protection is normally in standby (and therefore neither system requires frequent operator interaction), one operation that is periodically performed is the monthly fan swapping. The operators generally demonstrated the ability to perform this operation. However, some operators indicated that they did not follow the procedure completely. Specifically, the section of the procedure for swapping the Increment 3 exhaust fan calls for the operator to push and hold the reset button for a supply fan until room differential pressure decreases to 0.3 inch. However, the operator stated that he manually reduces the exhaust flow during the swap in order to minimize pressure swings, which is not called out in the procedure. Further, the section of the procedure for swapping the glovebox exhaust fans calls for the operator to push and hold the stop button for one fan while hitting the start button for the other. The operator stated that he pushes the stop button and then quickly hits the start button. The operator did not know why the procedure called for him to push and hold the stop button.

The OA team also evaluated the Building 332 minimum staffing requirements listed in the TSRs. These requirements specify that the facility operator position is to be staffed during normal working hours or when RMA activities are occurring. Further, a facility operator is to be on call during off hours when RMA activities are not occurring. The SAR states that facility operators will be in proximity to the control room during programmatic operations and facility maintenance activities. However, there is no document that defines what is intended by “in proximity.” Further, there is no analysis that justifies not having operators on site during off hours when RMA activities are not occurring. Although NMTP requires that a maintenance person monitor the Building 332 control room at all times and the probability and consequences of an event occurring after hours is less that it is during normal working hours (because few operations occur), there is no document describing the risk level and justifying not having operators on site to support emergency system operation in case of a system failure.

Summary. NMTP’s procedures and training have, in general, adequately prepared facility operators to operate the safety systems that OA reviewed. The operators demonstrated the capability to operate the equipment in a safe manner and to ensure that the systems would perform their function under normal and upset conditions. For the most part, system controls and indications are adequate to support system operations. However, some important weaknesses were identified, including out-of-date procedures, no alarm response procedures, limited system design training, and lack of training on recent system modifications. In addition, the operator aid procedure is not followed, resulting in unapproved/uncontrolled operator aids. Some weaknesses were also identified in operator performance, including lack of detailed understanding of some system operation specifics and failure to rigorously follow some operations procedures. These weaknesses, in large part, result from deficiencies in training and procedures.

E.2.6 Safety System Oversight

DOE has recently established requirements and expectations for both DOE and contractor oversight of safety systems. DOE oversight responsibilities are delineated in DOE Manual 426.1-1A (issued in 2004), which focuses on oversight of contractor efforts to ensure safety system operability. In addition, DOE has responsibilities for day-to-day facility operational awareness and review of facility safety assessments. Contractor requirements for safety system oversight are delineated in DOE Order 420.1A (issued in 2002). Both LSO and LLNL have established safety system oversight programs and are in the initial phases of implementing them. As discussed below, these programs are generally well defined and should result in safety improvements. However, some program weaknesses have reduced their effectiveness.

NNSA/LSO. The LSO Functions, Responsibilities, and Authorities Manual appropriately outlines its program for safety system oversight, and specifics are provided in an LSO standard operating procedure. This program is consistent with expectations specified in DOE Manual 426.1-1A and includes roles and responsibilities, training, and oversight activities. At the present time, LSO has identified the systems that fall within its oversight program and assigned personnel to become qualified for performing this oversight. Typically, an individual responsible for safety system oversight is assigned several systems (e.g., several ventilation systems) and is responsible for maintaining cognizance of the assigned vital safety systems, monitoring performance of the contractor's system engineer program, and confirming configuration management. LSO has clearly defined its training and qualification program and expects to have its safety system oversight personnel fully qualified by March 2006. LSO has also defined interactions between Facility Representatives, subject matter experts, and safety system oversight personnel, and they have appropriately delineated responsibilities for safety system oversight, with the Facility Representative having responsibility for day-to-day facility safety oversight. Safety system oversight personnel have begun to perform some of their oversight duties on safety systems, including performance of a broad-based assessment of the contractor system engineer program and participation in and evaluation of some contractor safety system assessments. A review of a sample of these early assessments indicated that they add value. Assessment summaries are captured in the LSO database (FISHE), and formal findings are issued for significant issues.

LSO has assigned two Facility Representatives to provide day-to-day oversight of the safety of Building 332 operations. Facility Representative duties include performing periodic facility walkthroughs and reviewing engineering design documents and facility modifications. The Facility Representatives have a good understanding of the operational conditions, and they are performing required walkthroughs that have found and appropriately documented some weaknesses in the facility operations for correction. However, the Facility Representatives did not identify a number of the weaknesses identified during this OA inspection. In particular, weaknesses in procedure maintenance, work control process implementation, and the QA program were not identified.

LSO also has the responsibility to review the SAR, USQ procedures, and facility changes. LSO's established protocols for performing documented safety analysis (DSA) reviews result in well-documented reviews. LSO's review of the 2002 DSA (called a SAR at that time) was thorough and identified many issues that needed to be addressed, including 37 conditions for approvals. Several of the conditions for approval identified deficiencies similar to those identified during this OA inspection, including design inadequacies and inadequate maintenance of the master equipment list. Furthermore, LSO's 2003 review of implementation of the site USQ process identified needed improvements. LSO formally tracks these issues and submitted the required 10 CFR 830 compliant DSA in October 2003.

Most aspects of the SAR review were well performed, but some aspects of closure of the conditions for approval of the corrective action plan have not been managed effectively. Although clear dates for closure of these conditions were assigned, some were not closed in time because LSO received unacceptable closure packages (e.g., inadequate supporting analyses). LSO did not establish appropriate mechanisms, including interim deliverable milestones and contingencies, to provide for timely closure in the event that initial closure packages were unacceptable. Some of the issues being resolved are complex and need effective communication and coordination. Currently, LSO is determining the appropriate actions to ensure effective closure and has issued three TSR violations to the contractor for failure to meet the conditions for approval.

LSO has ultimate responsibility for ensuring safe operation of Building 332 and has established programs for overseeing operations and addressing deficiencies. Although some aspects of its oversight programs have been effective, LSO has not been effective in ensuring that longstanding configuration management deficiencies at Building 332 are adequately addressed. As discussed in Section E.2.2, this is a significant issue that negatively impacts operational efficiency and safety.

LLNL. In early 2003, NMTP established a system engineer program with the objective of ensuring operational readiness of safety systems in accordance with requirements in DOE Order 420.1A. The system engineer program description provides requirements for qualifications and for facility- and system-specific training, and defines duties and responsibilities. Responsibilities include configuration management (including developing the system technical basis) and assessment of system status and performance. NMTP is in the process of implementing this program and has developed draft system technical basis descriptions for two systems (emergency power and criticality alarm system). Furthermore, NMTP has made system engineer assignments for all its safety-class and safety-significant systems and plans to have its engineers qualified by the end of 2004. NMTP has also requested additional funding to increase its system engineer staff by four persons (from its current staff level of five) so that each engineer will be assigned only one system.

These steps are positive, and given the current configuration management weaknesses, system engineering support is very important, particularly in the near term. Currently, system engineers have multiple duties that prevent them from giving adequate attention to the safety systems they have been assigned. In addition, some aspects of the system engineering program have not been well defined. For example, NMTP has developed draft system design documents for two systems, but has not established a standard defining how these documents are to be developed. Similarly, NMTP has not established protocols and criteria for performing system assessments. LSO and LLNL recognize these deficiencies and are working to address them. The first step is developing an implementation plan for meeting DOE Order 420.1A, which LLNL intends to finish by February 27, 2005.

Summary. Both LSO and LLNL are in the early stages of developing safety system oversight programs. The LSO oversight consists of three elements: monitoring of contractor safety system oversight, oversight of day-to-day operations by Facility Representatives, and the DSA review. Each of these elements is well defined, and the oversight and review programs have generated some useful products to support safety system operability. However, weaknesses were identified in the Facility Representatives' oversight of plant modifications and in LSO's oversight of the LLNL configuration management program. The LLNL safety system oversight program is captured in a system engineer procedure that adequately defines most aspect of the program and requirements for system engineers. However, the LLNL procedure does not define all appropriate elements, including plans for detailed assessments of safety systems and development of system design basis descriptions. Furthermore, LLNL has assigned its system engineers multiple systems and other duties that prevent them from adequately performing their safety system assessment and configuration management duties.

E.3 CONCLUSIONS

LLNL has established many appropriate elements for ensuring that safety systems can reliably perform their safety functions. The safety functions and design criteria of the ventilation and fire suppression systems are, in general, appropriately defined in the SAR, and in most respects these systems are appropriately designed to perform their safety functions under normal conditions, system upsets, and most accident conditions. Important design improvements have recently been made to improve system functionality, including modification of dampers to fail in safe directions and addition of a backup air supply to the dampers. In addition, most surveillances and tests are adequately performed, the systems are well maintained, and operators are knowledgeable of system operations and demonstrated the ability to appropriately operate the equipment under normal conditions and for surveillance and maintenance evolutions. Furthermore, both LSO and LLNL have recently improved their safety system oversight programs, which have identified some important issues at Building 332.

However, OA identified deficiencies in several areas. Deficiencies in engineering analysis and design, and in configuration management and quality assurance programs, are the most significant and could threaten the systems' ability to perform their safety functions in some scenarios. Deficiencies in surveillance and testing, implementation of work control processes, and operating procedures also reduce confidence in safety systems' performance.

Engineering analysis weaknesses include: (1) no analysis on the impact of combustible loading on HEPA filters, (2) no analysis supporting a building negative pressure TSR limit, (3) no analysis of the fire suppression system's ability to supply adequate flow to the safety-class deluge system, and (4) no analysis or validation of the ability of the Increment 3 room ventilation supply system to respond properly to accident conditions. Engineering design deficiencies include a fire suppression system design modification that relocated a pressure sensing line to a location that could cause system malfunction, and improper design of a backup nitrogen supply system.

Configuration management and QA deficiencies include lack of controlled, up-to-date drawings and incomplete documentation of the technical basis of the safety system design. Although some of these weaknesses can be attributed to the age of the facility, previous weaknesses in configuration management programs, and an expectation that Building 332 would be permanently shut down in 2000, these weaknesses impact the safety and efficiency of current operations and need to be addressed, particularly now that the plant life has been extended. Furthermore, significant deficiencies in the current configuration management and QA programs, such as incomplete program definition, poor maintenance of the master equipment list, and inadequate procurement processes, exacerbate the problems in system configuration management.

Although most TSR surveillance procedures are appropriate, identified concerns include one procedure that did not adequately test a TSR and several safety-class components that were not included in a TSR surveillance program. Weaknesses were also identified in the some aspects of the predictive maintenance program, tracking and trending of maintenance information, and rigorous application of the work control process. Finally, although operators generally demonstrate adequate knowledge and a good commitment to their duties, weaknesses were identified in operating procedures (out of date and lacking in formality), operator training (system training based upon reading an operating procedure that is not well maintained), and control room indications (missing labels, poor human factors, and unapproved informal operator aids).

LLNL management has not sufficiently ensured that important programs, such as configuration management and quality assurance, are rigorously defined and implemented and that longstanding configuration management deficiencies are addressed. Furthermore, management has not consistently ensured that work processes are rigorously implemented and that design weaknesses are addressed. LSO oversight has not been sufficient to identify some significant program weaknesses and ensure that identified weaknesses are addressed.

Furthermore, given the seriousness and extent of program and system design deficiencies, LLNL and LSO should take near-term actions to evaluate their collective impact on safe operation, the extent of the identified conditions, and the need for compensatory measures.

E.4 RATINGS

Engineering Design...SIGNIFICANT WEAKNESS
Configuration Management/Quality Assurance.......................................SIGNIFICANT WEAKNESS
Surveillance and Testing ....NEEDS IMPROVEMENT
Maintenance .... EFFECTIVE PERFORMANCE
Operations ....NEEDS IMPROVEMENT

E.5 OPPORTUNITIES FOR IMPROVEMENT

This OA inspection identified the following opportunities for improvement. These potential enhancements are not intended to be prescriptive or mandatory. Rather, they are offered to the site to be reviewed and evaluated by the responsible line management, and accepted, rejected, or modified as appropriate, in accordance with site-specific program objectives and priorities.

LSO

1. **Ensure that LLNL addresses longstanding configuration management concerns.** Specific actions to consider include:

   - Work with LLNL to ensure that a priority-based configuration management implementation plan is established in the near term.

   - Ensure that the priorities for Building 332 operations are balanced with priorities for resolving the longstanding configuration management deficiencies that negatively impact operational efficiency and safety.

2. **Improve oversight of day-to-day operations at Building 332.** Specific actions to consider include:

   - Reinforce the expectation that Facility Representatives perform oversight of plant modifications, including a detailed review of the adequacy of work packages.

   - Perform a formal evaluation of the QA program, particularly the program for procuring safety-related components.

3. **Perform an independent evaluation (or participate with LLNL in a joint evaluation) of the collective impact of the design and program deficiencies identified in this report on safe operations.** As an interim, near-term step, perform an assessment of legacy and current program weaknesses to determine the extent of condition and whether compensatory measures are warranted.

LLNL

1. **Upgrade engineering analysis supporting the SAR (and future DSA).** Specific actions to consider include performing formal analyses of the maximum allowable room combustible loading to assure

that the room exhaust HEPA filters will not exceed 10 inches w.c. dp for a design basis fire, and revising the TSR room combustible loading limits to incorporate the results of these analyses.

2. **Develop and implement a plan to address longstanding configuration management weaknesses.**

3. **Improve current configuration management plans.** Specific actions to consider include:

   - Revise the DNT configuration management plan to remove the "go forward" constraints that conflict with the ES&H Manual (for the configuration management program). Address the change evaluation requirements to ensure that configuration management processes for the current day-to-day work activities can be effectively implemented.

   - Finish revising and formally issue a current Master Equipment List and ensure that future updates are made on a timely basis.

   - Ensure that configuration changes from modifications are thoroughly identified and that changes are developed and approved, tracked to completion, and retained in historical record files.

4. **Improve the QA program plan and implementing procedures.** Specific actions to consider include:

   - Develop a Building 332-specific QA program plan, or revise the NMTP QA program to delineate all the duties of the QA organization.

   - Review and revise all QA implementing procedures to reflect the current practices and duties of the QA staff.

   - Ensure that provisions for independent validation of design procedures are clearly delineated in the work control manual and QA procedures.

5. **Improve procurement plans and processes.** Specific actions to consider include:

   - Ensure that procurement procedures adequately prevent existing material from being installed in safety-related systems unless the procurement inspections, certifications, and/or tests are completed and properly documented. As an initial effort, procurement documentation for spare items slated to be used in safety-related applications (e.g., spare motors and belts) should be reviewed and corrected as needed.

   - Establish a thorough review process for new like-in-kind determinations to ensure that the process is correctly implemented and that the final documentation, including the acceptance sheets, is properly completed.

   - Expedite the efforts for updating of the Building 332 procurement procedure to incorporate requirements from the LLNL institutional procurement procedure. Use the recommended dedication process/forms from the LLNL Procurement and Material Department to certify that commercially purchased material can be used in safety-related applications until the Building 332 procurement procedure is updated.

6. **Improve surveillance and testing procedures.** Specific actions to consider include:

   - Establish surveillance and test procedures for components that need to be added to the program, including fire protection system check valves, pressure control valves, pressure boundary valves, and system supports.

   - Review and revise as needed the surveillance procedure for room filter bypass dampers to ensure that the results of the surveillance satisfy the TSR surveillance requirements.

   - Review and revise the fire system surveillance procedures to ensure that setpoints are clearly defined so that out-of-specification results can be easily identified. Ensure that adequate reviews are performed on completed surveillances to make sure that out-of-specification results are marked, documented in the comments section, and addressed by NMTP.

   - Review all surveillance procedures against the requirements of the new procedure writer's guide and revise any deficient procedures. Place particular emphasis on ensuring a thorough review of fire system surveillances to ensure that the procedures are well written, with clear action steps, and supported by adequate datasheets.

7. **Improve maintenance plans.** Specific actions to consider include:

   - Revise the preventive maintenance task code (procedure) for Building 332 fans and motors to include detailed steps on using a belt tensioner gauge and laser alignment tool when replacing belts.

   - Establish a formal and detailed Building 332 predictive maintenance program document to describe the currently implemented program, especially in the areas of vibration monitoring and diesel generator crank case oil sampling. The document should justify the established monitoring and sampling frequencies.

   - Investigate the cause of the recent gap in oil sampling results for Building 332 and implement the necessary corrective actions to prevent recurrence.

   - Formalize a Building 332 trending and tracking program and establish the necessary personnel resources to implement the task. Also, consider improving the availability of material history information from Plant Engineering to the Building 332 system engineers.

   - Complete, in the near future, a Plant Engineering maintenance procedure that documents the currently implemented condition assessment survey process.

   - Improve the Condition Assessment Survey inspection sheet in two areas: improve the inspection criteria for the mechanical inspection survey, and include a data element on the inspection survey that shows the status of the equipment (operating or idle).

8. **Improve the work control process.** Specific actions to consider include:

   - Provide further guidance in the Building 332 Work Control/Design Change Control Process Manual to clarify the requirements for acceptance criteria and post-maintenance testing, including the necessary supporting documentation.

- Establish and document a formal review process for completed work packages to ensure that the required documents are included and properly completed. Ensure that deficiencies found during the reviews are shared with the document owners to help prevent future mistakes. Consider establishing document content checkoff forms to be completed by the document owner to ensure that the associated work package documents meet quality requirements.

9. **Improve operating procedures.** Specific actions to consider include:

   - Develop an operating procedure/program guide that clearly delineates all operators' duties and cross-references the specific implementing procedure for specific duties. Include in the document a list of all procedures and aids utilized by operators.

   - Revise the quality operating procedure QOP-1, "Preparation of Controlled Procedures," to reflect guidance in DOE STD-1029 and to establish specific formats for the different procedure types. Include sections on "precautions and limitations" and "prerequisites" as part of the procedure format.

   - Review and update all operator procedures and aids to conform to the writer's guide and to reflect current plant configuration and operation practices. In particular, review and update the monthly fan swapping procedure.

   - Enhance the operating procedures by developing alarm response procedures and an abnormal operating procedure for response to building fires.

10. **Improve operator training.** Specific actions to consider include:

    - Develop a specific training manual for each safety system, based on facility operating procedures (updated to reflect the current plant configuration) and the system design information developed as part of the system engineer program. Have operations coordinate with system engineers in developing the manual so that system-specific design information is tailored to the need of operations personnel.

    - Have system experts (e.g., system engineers) provide systems training. Include system walkdown evaluations as part of the training process.

11. **Improve operation controls.** Specific actions to consider include:

    - Review operation controls and upgrade as warranted. Some upgrades should be relatively inexpensive, such as adding appropriate labels.

    - Consider replacing the outdated ventilation system schematic display in the control room.

12. **Evaluate the technical basis for operator staffing requirements.** Evaluate the probability and consequences of safety equipment failure with and without operator intervention.

13. **Perform (separately or jointly with LSO) a management assessment of the collective impact of the design and program deficiencies identified in this report on safe operations.** As an interim, near-term step, perform an assessment of legacy and current program weaknesses to determine the extent of condition and whether compensatory actions are warranted. Include a management

assessment of the adequacy of current configuration management, QA, and operations programs to support maintenance of Building 332 essential systems. In the longer term, develop and implement plans to perform detailed technical reviews of Building 332 safety systems to determine the adequacy of SAR analyses, including supplemental analyses, supporting the SAR and TSRs.

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APPENDIX F

Management of Selected Focus Areas

F.1 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Independent Oversight and Performance Assurance (OA) inspection of environment, safety, and health (ES&H) at the DOE Lawrence Livermore National Laboratory (LLNL) included an evaluation of the effectiveness of the Livermore Site Office (LSO) and the University of California in managing selected focus areas. Based on previous DOE-wide assessment results, OA identified a number of focus areas that warrant increased management attention because of performance problems at several sites. During the planning phase of each inspection, OA selects applicable focus areas for review based on the site mission, activities, and past ES&H performance. In addition to providing feedback to National Nuclear Security Administration (NNSA) and contractor line management at LLNL, OA uses the results of the review of the focus areas to gain DOE-wide perspectives on the effectiveness of DOE policy and programs. Such information is periodically analyzed and disseminated to appropriate DOE program offices, sites, and policy organizations.

Focus areas selected for review at LLNL were:

- Management of legacy hazards
- Safety during excavation and blind penetration activities
- Unreviewed safety question (USQ) program
- Safety management for protective force training.

The scope of the review activities for each of these areas is further discussed in the respective subsections in Section F.2. Where applicable, the results of the review of these focus areas are considered in the evaluation of the core functions and feedback and improvement systems.

F.2 RESULTS

F.2.1 Management of Legacy Hazards

OA identified management of legacy hazards as a focus area across the DOE complex because a number of sites have legacy hazards that have not been addressed in a timely manner (e.g., unneeded hazardous materials in long-term storage, with no plan for disposition). At LLNL, the legacy hazards typically result from past use of hazardous materials, such as beryllium, volatile organic compounds, fuel oils, and polychlorinated biphenyls (PCBs), and past disposal practices. In addition, LLNL has a number of aging facilities that are not currently being used or that are deactivated and undergoing or awaiting environmental remediation. OA reviewed DOE Office of Environmental Management (EM), LSO, and LLNL management of legacy hazards focusing on Federal, state, and local environmental regulations; Occupational Safety and Health Administration (OSHA) and DOE/site requirements; integrated safety management (ISM) expectations; oversight; and the requirements of DOE Order 430.1B, *Real Property Asset Management*, in the areas of facility condition assessment, deactivation, and disposition. The OA team reviewed policies, requirements, procedures, guidance documents, plans, hazard control documents, and work practices for work within LLNL facilities; observed work associated with waste treatment processes; and conducted walkthroughs of facilities with potential hazardous legacy concerns.

LSO. LSO has provided effective oversight of LLNL's facility disposition process with respect to deactivation and disposition (D&D) of facilities. LSO provides direction to LLNL's D&D activities based on NA-52 Project Execution Plans, including Facilities and Infrastructure Recapitalization Program (FIRP) project execution guidance; approves FIRP project documentation; and tracks progress through the LLNL D&D monthly progress reports and walkdown of projects. LSO also monitors LLNL activities in response to the Defense Nuclear Facilities Safety Board (DNFSB) 60-day letter about hazardous material safety limit exceedences for some non-nuclear facilities. However, the identification and removal of legacy hazards has not been addressed as part of LSO's operational awareness activities. (See Appendix D for discussion of weaknesses in LSO oversight.)

LLNL. LLNL has implemented an aggressive program for disposing of legacy waste by the end of fiscal year (FY) 2005. During the July 2002 OA inspection, over 10,000 drum equivalents of transuranic waste, low-level waste, and mixed waste were stored outdoors in less than optimal conditions, with no firm schedule for disposal. EM has since accelerated disposal of this legacy waste and is on schedule to meet the FY 2005 goal. LLNL recently began sending transuranic waste drums to the Waste Isolation Pilot Plant, following certification of these drums by the National Transuranic Program's mobile vendor. Some transuranic waste remains, however, including drums that could not be certified because of contamination of the mobile vendor's glovebox and a number of large transuranic waste boxes. LLNL does not have a means for disposing of these large boxes because the items in the boxes must first be reduced in size, and LLNL does not have a facility for opening these large boxes. Drums containing uranium chips, which were a concern during the 2002 OA inspection because they were stored outside and near the site boundary, have been moved inside a large storage bay. A process for deactivating these chips has been developed and is currently being scaled up.

Although many actions are being taken to address legacy wastes, uncertainties remain with the waste management budget that could affect the disposal of legacy wastes and newly generated waste in FY 2005. The Congressional budget for waste management in FY 2005 is considerably ($4 to 7 million) less than the budget request. The LLNL Radioactive and Hazardous Waste Management organization has identified impacts that may result from underfunding, and concluded that funding constraints could impact LLNL's ability to ship all of the remaining legacy wastes in accordance with the established schedule. An additional $4 million for the 2005 budget has been requested.

In addition to the legacy waste initiative, LLNL senior management has made a strong commitment to reducing legacy hazards through institutional initiatives and the Ten Year Comprehensive Site Plan (TYCSP). LLNL has implemented a facility Condition Assessment System (CAS) that meets the requirements of DOE Order 430.1B, *Real Property Asset Management*, and is being used effectively to prevent facilities from becoming future legacy hazards. Facility condition assessments, conducted by multi-disciplined teams, are tailored to the facility hazard type, and assessments are conducted annually for all nuclear facilities and triennially for all other facilities. Results of the assessments are used effectively as a management tool for determining whether a facility should be considered as excess and entered into the institutional disposition process. A Government Accountability Office (GAO) report on Military Infrastructure, Real Property Needs, commended the LLNL CAS for its assessment practices. Although CAS processes have been effectively implemented, they have been accomplished largely on an expert basis, without a program plan or implementing procedures. The CAS program manager indicated that a maintenance operating procedure was being prepared to document expectations for program implementation.

LLNL uses the Chem Track system to control chemical inventories. With one exception, this tool has been used effectively to support annual inventories of all chemicals at LLNL. The exception involves insufficient trending and reporting of some inventory data (i.e., information about chemicals that are incorrectly written off if not found on an inventory but are found on subsequent inventories) to indicate the effectiveness of management control of chemicals and to hold owners of chemicals accountable for managing their inventories.

LLNL has an initiative to enhance controls for hazardous chemical inventories. For example, LLNL is working on integrating various related systems (Chem Track, the Hazards Control non-nuclear database, and the Electronic Ordering System) to facilitate implementation of controls and serve as a management tool for minimizing the accumulation of legacy materials in the future. Although these enhancements represent positive steps, management attention is needed to ensure that the planned enhancements will be completed on schedule (by the end of 2005). Some of the interim efforts (a preliminary analysis on tailoring Chem Track to the hazard level of the chemical) have been initiated but are not yet complete because of resource constraints.

LLNL senior management has focused attention on the removal of legacy equipment, facilities, and materials through its TYCSP. The FY 2005 TYCSP identifies the removal of legacy equipment, facilities, and equipment as a major LLNL management initiative, which is managed at the institutional level by the Institutional Facilities Management (IFM) organization. This initiative has been effectively implemented through an institutional process for the disposition of excess facilities and legacy materials and is now being used by all directorates. The laboratory space tax, restrictions on creating new space, and ES&H considerations are drivers that have been effective in reducing legacy hazards and reusing space.

IFM has implemented an aggressive institutional D&D process that has been used to reduce legacy hazards. IFM annually requests and ranks proposals from all directorates for projects to remove legacy facilities or materials. For funded projects involving D&D of excess facilities, facility owners are required to remove legacy materials and meet certain other checklist requirements before being accepted by IFM. Space Action Teams, funded by the program owner, are used in many instances to deactivate facilities, such as those within the Engineering and Chemistry & Materials Science Directorates. Once deactivation is complete, IFM may hold the facilities for reuse or ultimate demolition. During this time, surveillance and maintenance activities are tailored based on the ultimate disposition of the facility. Deactivation and disposition activities have been effective, resulting in 150 excess facilities, representing 400,000 square feet of space, being removed over the past ten years. The IFM institutional process has been actively used, as demonstrated by the 39 facilities, representing approximately 570,000 square feet of space, that are currently owned or managed by IFM, 42 percent of which are D&D projects. The Space Action Teams have been involved in the removal and disposition of various hazardous legacy materials, including disposition of 80 gas lecture bottles of rhenium hexafluoride from Building 231 and approximately 5 pounds of perchlorate salt from ductwork in Building 151.

LLNL has implemented a process to ensure that responsibilities for hazardous materials are transferred when employees terminate employment or are assigned a new position. A checklist is used to ensure that these employees have properly disposed of any excess hazardous materials. Some directorates, such as Engineering and Chemistry & Materials Science, have imposed additional requirements for removal of excess or legacy materials when employees transfer or terminate employment and when individual room responsibility is transferred.

OA conducted walkdowns of multiple facilities within three different directorates to determine the extent and effectiveness of initiatives to identify, remove, and control hazardous legacy items. A legacy remediation project within the Engineering Directorate was successfully applied at the Building 231 vault using available IFM processes and resulted in downgrading this vault from a Category 3 nuclear facility to a radiological facility. In addition, material and waste have been dispositioned from several buildings, including 5 tons of explosives from Site 300, and 1,500 kilograms of depleted uranium, 200 kilograms of beryllium, and over 30 containers of unknowns from the Building 232 Fence Area.

The Chemistry & Materials Science Directorate initiated a process in 2001 for the identification and removal of legacy hazards within the Building 151 Isotopes Sciences Facility, resulting in the effective reuse of laboratory space for new programs. Because of these efforts, approximately 5900 square feet of laboratory space that formerly housed legacy materials and equipment has now been restored to productive use. This effort was funded through the IFM process, with removal actions carried out by the institutional Space Action Teams. In addition, risk reduction activities are under way in Building 251, the Environmental Protection Department's Heavy Elements Facility, including the removal of most of the radiological legacy materials so the facility can be downgraded from its current Category 2 nuclear facility classification to a radiological facility by April 2005. At Site 300, the various divisions that have occupied space in facilities are using the institutional IFM process effectively for disposition of excess facilities. One facility at Site 300 (Building 828) will require a decision on its disposition in the near future because of its rapidly deteriorating condition.

The Physics and Advanced Technologies Directorate has made progress in the removal of materials at Building 194, including removal of more than four tons of various legacy metals from the building since 2002. However, a number of longstanding legacy hazards remain in and around the facility that management recognizes must be removed. These hazards include legacy equipment that reduce storage space for newly generated waste, such as drums of oil that are not protected from the weather, storage of materials outside in a roped radiation area that have been there for approximately two years, welding equipment with gas cylinders stored in one of the experimental caves without an assigned owner, and shelves that are sagging and overloaded with miscellaneous materials and equipment.

The Physics and Advanced Technologies Directorate designated Building 282, a facility that formerly housed a neutrino experiment, as excess, but chose to retain ownership and placed that facility in a "mothball" state approximately five years ago. A walkdown of the building showed that it is being maintained effectively and does not negatively impact safety or the environment. This walkdown also confirmed that the CAS was effective since information documented in the CAS reflected actual conditions.

LLNL has processed its plutonium and uranium materials as part of its excess inventories associated with DNFSB Recommendations 94-1 and 97-1, which address stabilization and packaging for long-term storage of excess plutonium and uranium in welded 3013 containers. LLNL is ready to ship the materials to the Savannah River Site but cannot do so because a disposition path does not exist. Acceptance of these containers is expected to be incorporated into the Savannah River Site Environmental Impact Statement/Record of Decision by March 2005. However, the State of South Carolina has taken the position that these materials cannot be accepted unless there is an ultimate disposition path out of the state. The only viable paths were treatment and immobilization at the Mixed Oxide facility; funding for the Mixed Oxide facility was "zeroed" out of the budget by Congress, and the immobilization project was cancelled.

LLNL has implemented several initiatives in response to the April 2003 DNFSB 60-day letter on the potential impact on nuclear facilities from non-nuclear facilities that have exceeded their hazardous materials inventory limits. An LSO/LLNL team performed a root cause analysis of occurrence reports at LLNL that identified a number of inventory control issues involving legacy materials and insufficient requirements for managing hazardous materials at non-nuclear facilities. As a result, LLNL initiated facility walkdowns to verify hazardous material inventories in seven of the higher hazard facilities. In addition, new safety basis requirements were prepared for non-nuclear facilities, strengthening the hazards analysis and control of hazardous materials in these facilities. Also, as discussed above, enhancements to the institutional Chem Track system were identified to strengthen the management and control of hazardous legacy materials. These initiatives, when fully implemented, should further strengthen LLNL's management and control of legacy hazards.

Summary. LLNL is making good progress in reducing legacy hazards through institutional initiatives and processes identified in the TYCSP, including an effective facility D&D process. An aggressive program for disposing of legacy waste by the end of FY 2005 is under way but could be impacted by a potential funding shortfall in FY 2005. These initiatives could be further strengthened through incorporation of legacy hazards management within LSO operational awareness activities, consistent management attention to legacy hazards and supporting institutional initiatives, and better documentation.

F.2.2 Safety During Excavations and Blind Penetrations

OA identified safety during excavations and blind penetration activities as a focus area because a number of sites have experienced events and near misses, as evident from site occurrence reports and OA inspection results. OA reviewed excavation and blind penetration activities to evaluate whether adequate controls have been established to ensure that these activities can be performed safely. Locator personnel were interviewed to determine their understanding of the relevant ES&H program requirements and their responsibilities. The OA team reviewed various documents and records, including project plans and program documents; ES&H procedures; ES&H manuals; contract provisions related to safety; subcontract provisions; selected aspects of staffing, training, and qualification of technical personnel; and various plans and initiatives.

LSO and LLNL recognize the potential hazards associated with buried utilities across the site. The site's history as a former Naval Air Station, along with historical installations of utilities that do not meet current codes and standards, results in a significant risk of injury during excavation activities. LSO has encouraged LLNL to establish rigorous safety requirements for any activities that require penetration of soils and concrete floors or walls, and LLNL has established requirements that have improved safety performance in these areas. Specifically, LLNL requires the issuance of a soil penetration and excavation permit for any activities that will penetrate more than 3 inches, including gardening and landscaping activities. The Maintenance Technical Administration Group (TAG) is responsible for issuing these permits.

Such permits must be requested at least 14 calendar days in advance of the intended work so that TAG has time to review applicable site drawings and perform the survey activities necessary to mark the identifiable utilities and subsurface obstructions. No work may proceed until TAG issues the permit, and the permit must be posted at the site throughout the excavation activities.

Once the locators receive the request, they perform the site survey using a variety of instruments, including radio transmission locators, magnetometers, and ground penetrating radar. The locators are thoroughly trained using these instruments and are very familiar with the instruments' advantages and limitations. Identified utilities are marked using industry-standard colors with paint, flags, stakes, and "whiskers." If these marks are obliterated during the excavation activity, the responsible individual is required to contact the TAG to request a re-survey or re-marking as necessary.

As with soil excavation and penetration, penetration of concrete floors or walls is subject to strict controls. Controls are also established for penetration of other walls. Surveys of concrete are required, and all obstructions within the concrete are marked by black tape. Disclaimers that embedded utilities cannot be distinguished from rebar are clearly identified in the penetration permit, and the permit is posted at the work site before work begins.

For both soil and concrete penetrations, once the locator survey has been completed and utilities or obstructions are marked, the site is photographed, and digital images are stored. These images are printed and included as part of the final permit for reference in case the marks become difficult to see. The images are also marked with the intended excavation boundaries or penetration site, allowing the responsible individual to confirm that the intended penetration site is safe.

Recognizing the inaccuracies in locating technology, the site requires use of non-destructive techniques for excavations within 30 inches of a marked utility or underground obstruction. This practice is more conservative than the industry and OSHA standard of 24 inches. Consequently, "pot-holers," a system that uses air or water to loosen soil that is then vacuumed into a tank, are used extensively. This excavation method significantly reduces the risk of damaging buried utilities and allows for positive location of buried utilities.

LLNL has adopted the use of utility marker balls prior to backfilling over utilities. These marker balls have an electronic system that can be activated by an above-ground instrument. The ball then transmits a digital code that is used to positively identify the marked utility, its actual position, and its depth. Straight utility runs are marked at 100-foot intervals, and all turns and junctions are marked.

Training for locators is extensive and performance-based. Each new locator must participate in six months of on-the-job training, where he or she works with a currently qualified site locator. After six months, the individual is sent to an industry locator training course, consisting of 40 hours of classroom training on the theory and operation of utility locator instruments, as well as a series of practical exercises. At the end of the week, the locator must successfully complete a final practical exercise in order to be certified as a utility locator. An individual cannot work independently until he/she has completed this course.

Despite these effective measures, a few utility strikes have occurred in the past year when the individuals performing the work did not follow the program requirements and restrictions. (See Finding #3 in Appendix C.)

Summary. LLNL is expending considerable effort to minimize the risk of striking buried and hidden utilities. All personnel conducting excavating activities are aware of the requirements to perform utility location surveys. When strictly adhered to, the excavation, soil penetration, and concrete penetration process at LLNL constitutes a noteworthy practice.

F.2.3 Unreviewed Safety Question Program

The USQ process is an important element of a nuclear safety program. OA inspections in the past few years have identified a number of generic deficiencies in site USQ procedures, which contribute to incorrect USQ screenings and evaluations. Some of these deficiencies stem from DOE guidance that is not fully effective in communicating the expectations of 10 CFR 830 requirements. OA has provided to the Office of Environment, Safety and Health (EH) an analysis of weaknesses in DOE Guide 424.1-1, and EH is in the process of revising the guidance to address these weaknesses.

OA is reviewing the USQ process as a focus area at most sites to provide feedback to the sites on USQ processes and to provide continued feedback to EH on the generic problems that need to be addressed on a DOE-wide basis through improved guidance. At LLNL, the OA team reviewed the sitewide USQ procedure, which was approved by LSO. The OA team also reviewed samples of completed USQ documents generated for proposed activities in Building 332, including 7 screenings and 11 USQ determinations (USQDs).

In most regards, the sitewide procedure correctly reflects the USQ requirements of the 10 CFR 830 and the guidance of the DOE Guide. Furthermore, the USQDs that OA reviewed were appropriately processed via the USQ procedure. No concerns or errors were identified in the USQDs.

However, concerns were identified with the USQ procedure and performance of USQ screenings. These procedure weaknesses are subtle but important, because they can result in premature and/or incorrect conclusions when LLNL processes proposed facility changes through its USQ procedure. Weaknesses were identified both in *criteria* used for performing USQ screenings or determinations and in *instructions* for performing screenings and USQDs. In addition, in three cases (of seven reviewed), the screenings incorrectly screened out changes, and therefore USQDs were not performed as required. These weaknesses are discussed in more detail below.

The weaknesses in criteria include:

- **Section 6.5 includes an inappropriate criterion for performing USQ determinations.** Section 6.5 lists the seven criteria questions required by 10 CFR 830 in a USQD. According to the rule, the last criterion is "Could the proposed change reduce a margin of safety?" The procedure inappropriately restates this as, "Could the proposed change reduce *the* margin of safety *as described in the facility's/activity's safety* basis?" [emphasis added to words different from the rule]. As worded in the site procedure, the question inappropriately limits the scope of the evaluation. This discrepancy is also reflected in the procedure's definition of "margin of safety" and in Section E.3, Question G.

- **Criterion 2a of Appendix B contains an inappropriate condition for screening changes.** Appendix B provides the guidance for *USQ First-Level Screenings* of various types of changes, and includes a criterion (Criterion 2a) that has two conditions for screening physical changes. One of the conditions is inappropriate; it refers to "...physical changes that clearly CANNOT result in new/increased hazard(s), new accident scenario(s) or increase probability/consequences of an accident scenario described in the facility safety basis." This condition is not appropriate for use in screening physical changes because the rule requires such a determination to be made through a USQD, which calls for a higher level of rigor and documentation than required for a screening.

- **Criterion 2b of Appendix B contains an inappropriate condition for screening changes.** Appendix B, Criterion 2b also contains two criteria for screening out proposed physical changes. The second refers to "Changes that would be considered normal commercial practices if not impacting equipment important to safety (i.e., changing florescent lighting fixtures in an office area)." The use of the word "Changes" in this criterion is not appropriate because, in the context of 10 CFR 830, "changes" are activities that leave the systems, structures, and components in a condition different from the previous condition. The activities addressed here, such as replacing light bulbs, are more appropriately described as routine maintenance activities rather than "changes" according to the rule's terminology. The incorrect use of the term "change" could lead to misapplication of the rule.

- **Criterion 3b of Appendix B contains inappropriate conditions for screening changes.** Appendix B, Criterion 3b for procedure changes contains provisions that are not appropriate for screening (e.g., considerations for new/increased hazards and increased probability or consequences). The rule requires that such considerations be made in a USQD; they are not a valid justification for a decision to *not* perform a USQD.

The weaknesses in the instructions for evaluating changes that could also result in inappropriate USQ screening or USQDs include:

- Sections C.1 and E.1 state that "The screening [determination] process in theses instructions focuses on explicit or implicit changes that affect the facility's documented safety analysis..." The use of the term "implicit change" is unclear and could be misleading.

- Section C.3 provides guidance for answering USQ screening questions. Several questions (Subsection I for facility changes, questions 11 through 17, and Subsection II for procedure changes, question 1) contain phrases requiring "determinations" that are tantamount to performing an informal, inadequately documented USQD to justify screening such changes. These phrases could result in an inappropriate screening and could lead LLNL not to perform the required formal USQD.

- On pages 47 and 50, questions are provided to help answer the USQD questions about whether the proposed change could increase the probability of an accident and/or a malfunction of equipment important to safety, respectively. One of the aid questions is, "Will the proposed change meet the design, material, and construction standards applicable to the structures, systems, and components being modified?" Although this is an important design question and was taken from the DOE USQ guide, it is not relevant to this application and could be misleading, because changes can meet all of the listed standards and still significantly increase the probability of an accident or malfunction. For example, changes involving rerouting of piping could be completely within the original standards, and yet could create unacceptable system pressures, temperatures, criticality conditions, and other negative effects on the system being changed and on other systems, structures, and components. Conversely, changes that do not meet the original standards could be safe and entirely within the existing documented safety analysis. Therefore, consideration of these standards is not relevant to the USQ questions and might lead to incorrect conclusions.

- On page 51, Question E provides guidance on answering the USQD question "Could the proposed change create the possibility of an accident of a different type than any previously evaluated...?" The procedure's guidance for this and the next question (quoted from the DOE Guide) states, "The possible malfunctions or accidents of a different type are limited to those considered to be as likely to happen as those considered in the safety basis." This statement imposes an additional, non-conservative probability consideration on these USQD questions that does not reflect the rule. The corresponding rule criteria simply ask whether the proposed change could lead to a new accident or malfunction, without regard to probability; probability is addressed separately and independently in two other USQD questions.

Several of these procedure weaknesses are attributable to incorrect or ambiguous guidance from the DOE Guide.

Finding #23. The site unreviewed safety question procedure does not fully implement 10 CFR 830 requirements.

The following three screenings incorrectly screened out changes, so that USQDs were actually required but were not performed:

- USQ # B332-03-12S, Rev 0, *Covering of the Floor Openings in Room 1006*, addressed installation of permanent coverings on two 12-inch diameter air duct openings and two smaller conduit feed holes through the floor in Room 1006. This change was incorrectly judged not to be a change to the facility as described in the documented safety analysis and thus was incorrectly screened out.

- USQ # B332-03-075-S, Rev 0, *Revision to OSP 332.188 Materials Characterization, Recovery, and Purification* addressed changes to this procedure, which allowed processing of samples in Room 1006 to separate beryllium from plutonium using microwave heating, caustic digestion of samples. The separation of beryllium from plutonium using a caustic was a new operation, and was not described in the safety analysis report (SAR). Therefore, according to the rule criteria, this change should not have been screened out.

- USQ # B332-03-066-S, Rev 0, *Revision of OSP 332.043 to add machine lapping operations*, addressed a procedure change for activities in Room 1362. This procedure had previously allowed only hand lapping; the changes allowed machine lapping and the moving of a lapping machine and associated tools into the room. This screening answered two screening questions incorrectly; contrary to the screening question answers, a procedure as described in the SAR was changed and the change involved a new operation that was not described in the SAR (i.e., machine lapping in the room). Therefore, the procedure change should not have been screened out.

In reviewing these concerns, Building 332 facility staff indicated that they interpreted the phrase from the rule (i.e., "procedures as described in the existing documented safety analysis") as clearly applicable to three types of procedures: technical safety requirement surveillance procedures, the facility safety plan, and administrative control procedures (typically, lower tier surveillance procedures). However, changes in other types of procedures, such as operating procedures and maintenance procedures, were routinely screened out of the process unless they were explicitly described in the SAR or the process to which they applied was explicitly described in the SAR. The primary personnel responsible for implementing the USQ process in Building 332 indicated that this interpretation, although not identified in their USQ procedure, was consistent with their training. Most types of technical procedure are described in Chapters 10, 11, and 12 of the SAR in numerous locations and contexts, and therefore, this interpretation was clearly contrary to the rule.

Additionally, one physical change to the facility was identified that was incorrectly treated as a "maintenance activity." It involved installing cuffs on cracked glovebox exhaust ductwork inside individual facility rooms. Since similar modifications had previously been made in the loft area, the staff incorrectly considered the installation of these different-size cuffs in a different area to be a maintenance activity. Therefore, it was never entered into the USQ process. This instance also represents a configuration management concern, which is further discussed in Appendix E of this report.

Finding #24. The unreviewed safety question process is not being executed in Building 332 in accordance with the requirements of the site unreviewed safety question procedure or 10 CFR 830.

An apparent conflict was also identified between the sitewide USQ procedure and the Building 332 *Work Control/Design Change Control Process Manual*. In several locations, the USQ procedure clearly indicates that proposed changes need to be determined to be safe before entering the USQ process so that the approval authority can be determined. The Building 332 Manual indicates in Section 3.5.3 that the

USQ process should be entered before the design change package is developed. The sequence for the design change control process in the Building 332 Manual is incorrect, because it is typically necessary to have a design change package, containing details about the proposed change and its impacts on safety, before an USQ review can be performed at the appropriate level of detail.

Summary. In most regards, the sitewide procedure correctly reflects the USQ requirements of 10 CFR 830 and the guidance of DOE Guide 424.1-1. Furthermore, in general, USQDs are appropriately and correctly processed via the USQ procedure. However, the sitewide USQ procedure contains some subtle but important deviations from the 10 CFR 830 rule language, possibly leading to inappropriate USQ screenings or USQDs. In addition, there were cases where changes were incorrectly screened out and the required USQDs were not performed.

F.2.4 Safety Management for Protective Force Training

A recent Inspector General report identified weaknesses in some aspects of site Basic Security Police Officer Training programs and identified a need for increased safety management for protective force training. The DOE corrective action plan for the Inspector General report committed OA to examine selected aspects of protective force training from a safety management perspective on OA ES&H inspections.

At LLNL, OA reviewed the University of California contract for DOE firearms training and qualification requirements. In addition, OA evaluated the Site 300 Small Firearms Training Facility (SFTF) for appropriate hazards analysis and safety documentation of its firearms training facilities. OA also reviewed selected aspects of LLNL feedback and improvement activities and LSO line management oversight as they apply to protective force training activities.

Hazards Analysis During Protective Force Training. LLNL's protective force is armed, and therefore is subject to the DOE firearms training and qualifications standards contained in the University of California's contract for operating LLNL. LLNL maintains a number of protective force training facilities, including the SFTF at Site 300. This facility is used by LLNL security personnel and outside agencies for basic and advanced firearms training. The LLNL SFTF (Building 899 Complex) consists of four live-fire ranges—a qualification range, a tactical range, a rifle range, a Live Fire Shoot House—as well as support buildings.

The training-related hazards associated with the operation of the SFTF associated with firearms, live fire, live-fire tactical activities, and ammunition handling. Specifically, these hazards include injuries resulting from being struck by a projectile fired from a firearm; hearing damage to shooters and observers at SFTF; eye injuries to shooters and observers; exposure to lead by users of the SFTF; accidental detonation of ammunition stored at the SFTF; mechanical hazards associated with the different types of firearms; breech rupture due to muzzle obstructions; slips, trips and falls; and ergonomic-related injuries from physical training and exercises.

A hierarchy of safety documents describes the mechanisms for identifying and analyzing these hazards, establishing and implementing safety controls, and performing work safely. In general, the protective force training hazards analysis process utilizes the LLNL hazards analysis process as described in ES&H Manual Document 2.2, *Managing ES&H for LLNL Work*. At the facility level, hazards and engineering design and administrative controls are well defined in a facility safety plan. As a low-hazard facility, the SFTF operates under a risk analysis report as the facility safety basis document. The risk analysis report provides a well-written, easy-to-understand overview of the facility hazards, risk control measures, accident assessments, range operations, and the conduct of operations program. Operating procedures have been developed to ensure that the controls identified in the facility safety plan are in place and are maintained.

At the activity level, lesson plans are required for any SFTF firearms training activity. An integration work sheet (IWS) identifies the specific hazards associated with the training and the methods of hazard control. IWSs have been developed for each firearms facility and for crosscutting activities, such as obstacle course training. IWSs reviewed by the OA team are well developed and address the major hazards and controls associated with the training activity or facility. The firearms instructors use the IWS documentation as a guide in implementing safety requirements into the training development cycle. LLNL ES&H Team 4 safety engineers are effectively integrated into the development, review, and implementation of IWSs. An innovative and useful element of the hazards analysis process at the activity level has been the establishment of work permits, which serve as a bridging document to ensure a second level of review of documents associated with a specific activity (e.g., obstacle courses).

Overall, the hazard identification and analysis process for the protective force training is logical, robust, and well documented. However, the injury rates for the protective force are the highest among all LLNL directorates. Furthermore, over 80 percent of the injuries incurred by the protective force are associated with training. The Safeguards and Security Division has recognized and analyzed this concern, and actions have been identified to target injuries and reduce their recurrence.

The IWS hazard identification and analysis process for a typical training exercise (i.e., Team Tactical Movement and Live Fire Obstacle Courses) is detailed and provides a thorough description of the activity, potential hazards, and expected controls. However, some aspects of hazard control procedures, documentation, and communication are not rigorous. For example, the work permit process, although a valuable tool for ensuring the adequate safety documentation, is not sufficiently documented in a procedure or instruction consistent with ES&H Manual Document 3.4, *Preparation of Work Procedures.* Furthermore, although protective force management has the expectation that the instructor will tell the students about the hazards and controls for a training exercise, as defined in the IWS prepared for that exercise, during the pre-job briefing, there is no mechanism, such as a procedure or instruction, to ensure that instructors communicate the IWS hazards and controls, to verify that students have read and understood the IWS, or to afford students the opportunity to raise questions about the hazards and controls. (See Finding #2 in Appendix C.)

LLNL Feedback and Improvement. Feedback and improvement processes in the Safeguards and Security Division are governed by institutional requirements specified in the ES&H Manual and by internal requirements in Departmental quality assurance procedures. This Division is proactively making improvements in feedback and improvement processes, mapping out management processes, and developing additional quality assurance administrative procedures. An injury and illness improvement program has been established for calendar year 2004 to address high injury and illness rates. The program includes several ES&H training courses for Division supervisors and management reviews of ES&H policies and practices.

Facility-condition ES&H inspections and focus-area self-assessments are scheduled and performed using structured checklists. Deficiencies are input to the LLNL issues tracking system and tracked to closure. Lessons learned are communicated to supervisors and addressed at safety meetings. However, the same weaknesses identified during this inspection in other LLNL organizations were evident in the Safeguards and Security Division's processes and performance for feedback and improvement, including self-assessments, issues management, lessons learned, and injury and illness investigations. For example, the focus-area assessments are generally not performance-based (e.g., the structured checklists lines of inquiry do not focus on the effectiveness of implementation). Findings #9, 10, and 11 are applicable to LLNL, including the Safeguards and Security Division (see Appendix D).

LSO Oversight. The LSO Safeguards and Security organization oversees LLNL site protective force activities, including protective force training. LSO safety personnel have monitored LLNL protective force training and exercise processes for many years. Required surveillances, such as the annual programmatic assessment of LLNL firearms safety, are performed by LSO and Albuquerque Service Center firearms subject matter experts. However, LSO safety oversight of protective force activities has been mostly informal; it is not formally documented in procedures, assessments or official approvals of site protective force training plans and exercise documentation. (See Findings #8 and 9, Appendix D.)

LSO is currently working to integrate safety into the protective force training and certification process, as indicated by their involvement in the Laboratory Protective Force Working Group, a forum for discussing and resolving safety-related training issues. The 2004/2005 periodic safeguards and security survey of LLNL is to include protective force training as a focus issue, and Protection Program Operations has indicated that safety will be a significant element in that survey process.

Summary. Hazards related to protective force training at the firearms training facilities are sufficiently identified and analyzed. Some aspects of hazard control procedures, documentation, and communications warrant further improvement. LLNL is taking actions to address injury rates at the site, which are high compared to other DOE facilities. LLNL feedback and improvement processes and LSO oversight need to be improved across the site, including their application to protective force training activities.

F.3 CONCLUSIONS

For the most part, NNSA, EM, LSO, and LLNL have been proactive and effective in addressing the complex issues associated with the focus areas that OA reviewed during this inspection. EM, LSO, and LLNL have been proactive in addressing legacy hazard issues and have made considerable progress. Similarly, LSO and LLNL have developed a noteworthy program for controlling hazards associated with electrical penetrations. LSO and LLNL also self-identified concerns about the protective force injury rates and have initiated some corrective actions.

However, a number of areas need increased attention and additional improvements. The USQ procedure and its implementation are deficient with respect to USQ screenings. Procedure adherence problems, similar to those identified in Appendix C at various LLNL organizations, have resulted in a few electrical strikes. The weaknesses in LLNL feedback and improvement and LSO oversight processes, as detailed in Appendix D, are also evident in the site's management of the USQ process and protective force training.

F.4 OPPORTUNITIES FOR IMPROVEMENT

This OA review identified the following opportunities for improvement. These potential enhancements are not intended to be prescriptive or mandatory. Rather, they are offered to the site to be reviewed and evaluated by the responsible line management, and accepted, rejected, or modified as appropriate, in accordance with site-specific program objectives and priorities.

LSO/LLNL Management of Legacy Hazards

1. **Strengthen LSO oversight of LLNL management of legacy hazards.** Specific actions to consider include:

    - Incorporate legacy hazards as a focus area in LSO operations team leader charters.

    - Revise operational awareness documents, implementation plans, and associated procedures to reflect oversight of LLNL management of legacy hazards, including those associated with facilities, equipment, and materials.

2. **Develop a disposition path for the oversized transuranic boxes currently stored in Building 696S.** Specific actions to consider include:

    - Identify alternative processes for size reduction and decontamination of equipment in oversized transuranic boxes.

    - Seek funding sources for disposition of the oversized transuranic boxes via preparation of proposals to LSO and/or IFM.

3. **Improve institutional processes aimed at management of legacy hazards.** Specific actions to consider include:

    - Complete preparation and approval of CAS program documents, including the Maintenance Operating Procedure, which describes the process for implementing the CAS program.

    - Strengthen program owner accountability for chemicals. Implement a formal management feedback system for significant "finds" of hazardous chemicals located by Chem Track technicians that previous program owners had written off.

    - Conduct regular management reviews to track schedules and ensure that sufficient resources are available to support development and implementation of Chem Track enhancements by the end of FY 2005.

    - Complete the analysis of available hazard rating methodologies and make recommendations to management for inclusion in Chem Track.

    - Aggressively pursue funding and support from the institutional process to reduce longstanding legacy materials that have not received sufficient management attention.

4. **Decide whether to retain or demolish Building 828 at Site 300.** Specific actions to consider include:

    - Develop and implement an effective surveillance and maintenance plan to prevent recurrence of its present deteriorated condition, if the facility is retained.

    - Review surveillance and maintenance activities at other facilities at Site 300 to ensure that they are not deteriorating like Building 828.

5. **Continue efforts to identify and remove longstanding legacy hazards in and around Building 194.** Specific actions to consider include:

   - Develop a comprehensive, prioritized list of all unneeded legacy and other hazardous items in and around Building 194 and commit to a schedule for their removal.

   - Consider the use of a Space Action Team to assist in the removal of identified legacy items at Building 194.

   - Consider submitting a legacy removal project proposal to IFM using institutional funds for Building 194.

LLNL USQ Program

1. **Enhance the sitewide USQ procedure, the Building 332 Manual, and implementation of the USQ screens.** Specific actions to consider include:

   - Formally replace the current Building 332 USQ screening practice that allows screening out procedure changes to all but technical safety requirement surveillance procedures, the facility safety plan, and administrative control procedures with a policy that requires virtually all technical changes in Building 332 technical procedures to undergo a USQD. Provide formal, documented retraining to all currently qualified and future USQ screeners, evaluators, and approvers on this policy revision.

   - Provide formal, documented training to personnel associated with design change activities to ensure their understanding that changes approved for one location or application in the facility may not be extended to other areas or applications without using the formal design change process, and that such changes in new locations or applications may not be performed simply as maintenance activities.

   - Revise the Building 332 *Work Control/Design Change Control Process Manual* to show that the USQ process should be entered *after* the design change package is generated in order to provide enough detail to adequately execute the USQ process.

   - Perform a more extensive review of the actual recent (last two years) USQ screenings performed to determine whether the results observed by the OA team are endemic. Reevaluate all screenings found to be incorrect, and take the appropriate USQ actions.

   - Address the specific deficiencies in the sitewide USQ procedure criteria and instructions. Perform a review of the revised procedure to ensure conformance with the rule.

LLNL Protective Force Management

1. **Perform assessments of protective force training and application of LLNL feedback and improvement to protective force activities.** Focus on application of sitewide corrective actions in the areas of work control (e.g., IWS) processes, work instruction quality, procedure adherence, activity-level feedback, assessments, issues management, and lessons-learned processes.

LSO Protective Force Oversight

1. **Institute formal processes for performing assessments and self-assessments of LSO oversight of protective force training.** Focus assessments on LLNL's application of sitewide corrective actions to protective force training. Focus self-assessments of LSO on determining the effectiveness of ongoing initiatives and institutionalization of the safety oversight processes for protective force activities.